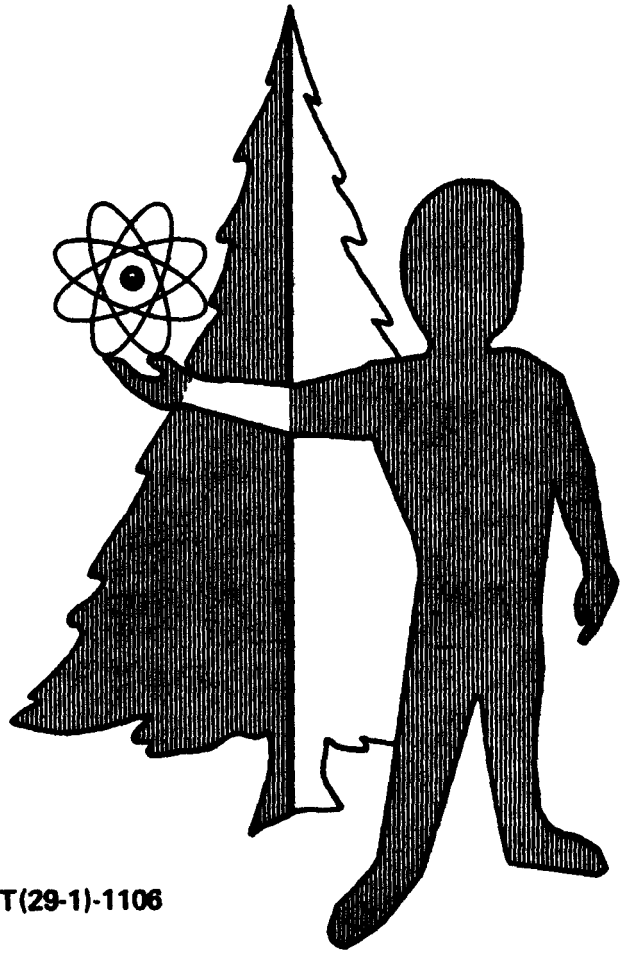
RFP-ENV-72

April 13, 1973

ANNUAL ENVIRONMENTAL MONITORING REPORT

Rocky Flats Plant

JANUARY – DECEMBER 1972



DOW CHEMICAL U.S.A.

Rocky Flats Division

U S ATOMIC ENERGY COMMISSION CONTRACT AT(29-1)-1106

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ANNUAL ENVIRONMENTAL MONITORING REPORT
ROCKY FLATS PLANT

January through December 1972

Including Estimates of Releases to the Environment
from Plant Operations

Merlyn R Boss, Farrel D Hobbs, Robert W Loser,
and Donald E Michels

DOW CHEMICAL U S A
ROCKY FLATS DIVISION
P O BOX 888
GOLDEN, COLORADO 80401

Prepared under Contract AT(29 1) 1106
for the
Albuquerque Operations Office
U S Atomic Energy Commission

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INTRODUCTION

The Rocky Flats Plant is owned by the U S Government and operated by Dow Chemical U S A under contract with the U S Atomic Energy Commission The plant is located in Jefferson County, Colorado, about 16 miles northwest of Denver (Figure 1)

The site consists of about 2,520 acres of fenced property At the approximate center of the site is the controlled area consisting of 384 acres, in which the production and manufacturing buildings are located

The Rocky Flats Plant is primarily a radioactive metal fabrication and chemical processing plant, consisting of foundries, fabrication shops, chemical recovery and purification operations, together with associated support functions

Annual precipitation recorded at the site during 1972 was 14 78 inches, with a record of 24 67 inches during 1969 The extreme temperatures recorded during 1972 were −12° to 96°F, with an annual mean temperature of 69°F The mean wind velocity was 7 7 miles per hour, with a peak gust of 105 miles per hour on January 11, 1972 The predominant wind direction during 1972 was from the northwest, and occurred during 21 percent of the hourly observations Peak gust wind velocities in excess of 50 miles per hour occurred monthly, except during late summer and early fall

The area is nearly devoid of trees Assorted low-growing prairie grasses, prickly pear, yucca or spanish bayonet cactus, constitute the main ground cover

Surface water runoff from the Rocky Flats Plant is from west to east Runoff is carried from the property by two major drainage basins, the North and South forks of Walnut Creek on the north, and Woman Creek lying to the south South Walnut Creek is considered to be the main effluent water course The confluence of North and South Walnut Creeks lies just east of the government property (see Figure 2) East of the confluence is Great Western Reservoir Woman Creek flows east from the government property and into Mower Reservoir, then into Standley Lake North Walnut Creek, South Walnut Creek, and Woman Creek are considered to be effluent-release routes and have been designated A, B, and C, respectively

The environmental monitoring program at the Rocky Flats Plant is the responsibility of the Environmental Control group of the Research and Ecology Division The information and data contained in this report were released monthly to the Rocky Flats Area Office of the U S Atomic Energy Commission, the Division of Occupational and Radiological Health of the Colorado Department of Health, and the Regional Office of the Environmental Protection Agency The Colorado Department of Health also maintains air-, soil-, and water-sampling programs around the Rocky Flats site as a portion of their statewide surveillance

SUMMARY

Results of the environmental monitoring program in the vicinity of the Rocky Flats Plant during 1972 indicate that yearly average environmental concentrations of plutonium in air and water was less than 2 percent of applicable Federal Standards Total long-lived alpha emitter concentrations in air, including natural background, was less than 30% of the soluble plutonium-239 standard No apparent changes were noted in the distribution of plutonium in soil from previous years Changes in the distribution isopleths compared with 1971 are a result of additional sample results in the computer modeling program and do not reflect physical movement of plutonium in soils

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MONITORING DATA COLLECTION, ANALYSIS, AND EVALUATION

Applicable Standards

The numerical guides governing the release of radioactive effluent materials and the concentration standards for radioactivity in environmental samples are those found in AECMC-0524 [1] Although the standards for radioactivity relate to concentrations above background, all measurements reported herein include background radioactivity

All radioactive isotopes in plant effluents and environmental samples are assumed to be soluble for purposes of comparison with the appropriate concentration standards The assumption concerning solubility is an additional safeguard since the Maximum Permissible Concentration (MPC) guidelines for soluble radioisotopes are more restrictive than those for insoluble radioactive materials Concentrations of total long-lived alpha activity in airborne effluents from the plutonium areas are maintained below $0\ 06 \times 10^{-12}$ μCi/ml, the soluble plutonium-239 concentration standard set for an individual in an uncontrolled area Airborne effluents from the uranium areas are maintained below $0\ 3 \times 10^{-12}$ μCi/ml The concentration of uranium plus plutonium in effluent water is maintained below 1667×10^{-9} μCi/ml, the soluble plutonium-239 concentration standard set for a suitable sample of an exposed population The comparable standard for americium-241 is 1333×10^{-9} μCi/ml The standards given in AECMC-0524 indicate that soluble plutonium-239 concentrations to a maximum of 5000×10^{-9} μCi/ml are permissible in water at the boundary of the controlled area

The Environmental Protection Agency's proposed standard for beryllium as defined in Subpart C of 40CFR Part 61 requires that total emissions be less than 10 grams in a 24-hour period [2]

Effluent waters containing chemical contaminants from plant operations are controlled so that they will meet the receiving water standards of the Colorado Department of Health[3] combined water-use classifications AB_1 –CD_1 for a potable drinking water supply, cold water fishery, water for industrial uses, and water for irrigation

Airborne Effluent Monitoring

Primary control of airborne radioactive and non-radioactive effluents is exercised at the discharge stacks All effluent exhaust systems are isokinetically sampled on a continuous basis Each release point is provided with at least two effluent sampling stations in all plutonium facilities Effluent air samples from the plutonium and uranium buildings are analyzed by direct counting for total alpha activity Effluent beryllium concentrations from the appropriate buildings are determined using the atomic absorption method [4] Minimum Detectable Concentration (MDC) for effluent samples from the plutonium areas is $<0\ 002 \times 10^{-12}$ μCi/ml The effluent MDC from the uranium areas is $<0\ 001 \times 10^{-12}$ μCi/ml, while the MDC for a typical beryllium effluent sample is $<0\ 0002$ $\mu g/m^3$

Table 1 shows the quantities of total long-lived alpha emitters and beryllium released from the plutonium, uranium, and beryllium production areas The total releases shown in Table 1 also include long-lived alpha activity due to natural background

Ambient Air Surveillance Monitoring Programs

Ambient air monitoring of filterable airborne particulates containing long-lived alpha and beta emitters is conducted continuously at the plant The sampling network within the controlled area presently consists of 12 air samplers, five of which are located at the perimeter fence (see Figure 3) The samples are collected daily on Whatman 41 filter media

The sampling pumps (Gast, Model 0465–V4A–025) operate at an average sampling rate of 2 cfm All samples are analyzed daily by direct radiometric counting and then allowed to decay for seven days prior to determining the long-lived alpha activity

Although Rocky Flats Plant operations release only trace amounts of beta-emitting radionuclides, the samples which are collected on Friday of each week are also analyzed for long-lived beta emitters

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following a seven-day decay These data comprise part of the U S Atomic Energy Commission fallout monitoring network as well as providing radiological background information

Air samplers operating at 2 cfm are operated for 10 minutes out of each hour in the surrounding communities of Boulder, Broomfield, Denver, Golden, Lafayette, Marshall, and Westminster (see Figure 4) Other 2-cfm samplers are operated continuously at the mouth of Coal Creek Canyon (S-11, three miles west-southwest of the site) and Wagner (S-18, 2 5 miles southeast of the site) The air samples are collected on Whatman 41 filter paper and are analyzed weekly Then they are allowed to decay for seven days before determining the long-lived alpha and beta concentrations

The MDC for long-lived alpha activity in community samples collected ten minutes of each hour is typically $<0\ 0045 \times 10^{-12}$ μCi/ml The continuously operating community sample MDC is $<0\ 0008 \times 10^{-12}$ μCi/ml Sample MDC's for long-lived alpha activity from the controlled area range between $<0\ 0055 \times 10^{-12}$ μCi/ml for a daily sample to $<0\ 0018 \times 10^{-12}$ μCi/ml for a sample collected over the weekend Typical MDC's for a long-lived beta activity in samples taken within the controlled area of the Rocky Flats Plant are $<0\ 0629 \times 10^{-12}$ μCi/ml, whereas the community sample MDC's are about $<0\ 0513 \times 10^{-12}$ μCi/ml The monthly average concentrations of long-lived alpha emitters from the various communities are shown in Table 2 together with the corresponding concentrations from the sampling network located within the controlled area of the Rocky Flats Plant The yearly summary in Table 2 shows the average concentration, in all samples collected from the communities surrounding the Rocky Flats Plant, to be $<0\ 0048 \pm 13\% \times 10^{-12}$ μCi/ml *

Table 3 shows the average monthly long-lived beta concentrations for the surrounding communities and the Rocky Flats site The average beta concentration in air samples from the surrounding communities (including natural background) is $<0\ 1078 \pm 21\% \times 10^{-12}$ μCi/ml

High Volume Air Sample Network

In February 1971, a network of 12 continuously operating high volume air samplers were installed at approximately two to four miles radially from the Government property (locations S-26 through S-37, shown in Figure 4) The samples are collected daily on Whatman 41 filter paper at an average flow rate of 20-25 cfm The daily filters are composited into weekly samples, whose total volumes vary between 3,000 – 6,000 m^3, depending upon the condition of the sampling pump These sample filters are radiochemically analyzed specifically for plutonium following isolation on an ion-exchange column [5] The chemical plutonium recovery for individually composited samples is determined (internally yielded) by adding a known quantity of plutonium-236 tracer and quantified by means of alpha pulse height analysis One-half of the daily sample filters are retained in order to provide a check on anomalous air concentrations Typical MDC's for plutonium range down to $<0\ 01 \times 10^{-15}$ μCi/ml for a 5,000 m^3 sample

Weekly results for individual stations have been reported on a monthly basis to the U S Atomic Energy Commission, the United States Environmental Protection Agency, and the Colorado Department of Health The stations comprise a statistically homogeneous group,* as indicated in Table 4 Furthermore, the data for individual stations also comprised homogeneous sub-groups in all cases but one ** Since all stations are statistically homogeneous, their data can be combined For each week of sampling, the analyses

*Throughout the data presented, samples whose concentrations were below the MDC are assumed to be the MDC for averaging purposes. The minimum and maximum concentrations at each location are shown, together with the uncertainties in the analysis due to counting error at the 95 percent (2σ) confidence level The error term associated with the average concentration at each location represents the deviation (at the 95 percent confidence level) of the mean of the sample concentrations observed

$$\text{i e , } C_{avg} \pm 2\sigma = \bar{c} \pm t_{0\ 975}\sqrt{\frac{\Sigma C_i^2 - \bar{c}\,\Sigma C_i^2}{n(n-1)}}$$

$\bar{c}$ is volume weighted whenever the volume is measured
n is the number of samples

*Log-normal statistics are used in the numerical analysis of data from these stations [6]

**Station S-34 yielded four samples that were anomalously large compared to the remaining samples. However, the truncated group of 46 samples yields the lowest geometric standard deviation (GSD) observed (Table 4), suggesting that the four high samples should be regarded as part of the background distribution

were averaged Values are shown in Figure 5 and listed in Table 5 The year-long geometric average plutonium concentration is 0 000044 μCi/ml X 10^{-12} multiplied or divided by 1 33 * For purposes of comparison with earlier results, the volume-weighted monthly arithmetic station averages for the high-volume air sampler network are shown in Table 5-A

Waterborne Effluent Monitoring

Daily effluent water samples are collected from the outfalls of Ponds A, B-4, and C (Figure 2) The daily samples are analyzed for pH, nitrates, phosphates, fluorides, and hexavalent chromium BOD_5 and dissolved oxygen are determined in Pond B-4 three days each week [5]

These daily samples are composited into weekly samples for analysis of combined uranium and plutonium (gross alpha) and specifically for plutonium The weekly samples from Pond B-4 also are analyzed specifically for americium The combined alpha activity from uranium and plutonium are isolated from other long-lived alpha emitters using an ion-exchange technique [5] All effluent water samples are internally yielded for plutonium using a plutonium-236 tracer Samples analyzed for americium are internally yielded using a curium-244 tracer The uranium, plutonium, and americium alpha activities are determined from pulse-height analysis of the samples The minimum detectable sample concentration for uranium, plutonium, and americium in water is <0 01 X 10^{-9} μCi/ml

The weekly composite samples are further composited into monthly samples in which the concentrations of 42 different elements are determined These analyses are performed using emission and atomic absorption spectrometry Monthly composite samples are combined quarterly and analyzed by standard methods[7] for the various nonradioactive constituents shown in Table 6

Radioactive concentrations in the holding ponds from which samples were collected are shown in Tables 7, 8, 9, and 10 The annual average concentrations of plutonium-239 in Ponds A, B-4, and C were <1 68 X 10^{-9} μCi/ml, 14 86 X 10^{-9} μCi/ml, and <1 33 X 10^{-9} μCi/ml, respectively The americium-241 concentration in Pond B-4 averaged <2 15 X 10^{-9} μCi/ml The estimated total releases of the radionuclides processed at the Rocky Flats Plant and released in effluents from Pond B-4 are also shown in Tables 8 and 10 The yearly average concentration in samples collected from Pond B-4 have been volume weighted, since the flow rate is measured at the outfall from this pond Flow rate measurements from Pond B-4 were supplied, since June, by the Denver Office of the U S Geological Survey when construction at this location forced the closure of the sampling and volume measurement station Flow rates through Ponds A and C are not presently measured

Daily water samples also are collected from Walnut Creek at Indiana Street, upstream from Great Western Reservoir, for weekly compositing Radioactive analysis on these samples is identical to those of Pond B-4 The results of these samples are shown in Table 11 The annual average plutonium-239 and americium-241 concentrations at this location were 8 82 X 10^{-9} μCi/ml and <1 01 X 10^{-9} μCi/ml respectively

Regional Water Monitoring Program

Semimonthly water samples are collected from four reservoirs and nine tap water locations around the Rocky Flats and greater Denver areas The reservoirs include (1) Baseline, whose primary use is a source of irrigation water, (2) Ralston Reservoir, the water supply for portions of Denver, Arvada, Wheatridge, and the Rocky Flats Plant, (3) Great Western Reservoir, which is the Broomfield water supply, and (4) Standley Lake, which serves Westminster and portions of the Thornton-Northglenn area (see Figure 4) Tap or treated water is collected from the surrounding communities of Arvada, Boulder, Broomfield, Denver, Golden, Lafayette, Louisville, Thornton, and Westminster These data are summarized in Table 12 and include background radioactivity The annual average plutonium-239 concentration in all reservoirs was

*Uncertainty in mean value is commonly expressed as a plus or minus value Denotation of uncertainty takes a different form when log-normal statistics are used The term 0 000044 multiplied or divided by 1 33 means that the limits of uncertainty on the mean value 0 000044 are given by 0 000044 X 1 33 and 0 000044 – 1 33 In this case, and in all other tables and graphs in this section, the factors for uncertainty pertain to 95 percent confidence levels

$<0.48 \times 10^{-9}$ μCi/ml and $<0.31 \times 10^{-9}$ μCi/ml in all treated water samples. Analysis for americium is routinely performed on water samples from Great Western and Standley Reservoirs. These data are presented in Table 13. The annual average americium-241 concentration in all reservoirs was $<0.29 \times 10^{-9}$ μCi/ml.

Twice each year – normally in June and September – water samples are collected from additional surrounding reservoirs, lakes, and streams. Samples are collected out to a distance of about 20 miles from the plant and are analyzed for gross alpha (combined uranium and plutonium) and specifically for plutonium. These data are presented in Table 14 and include background radioactivity. The annual average plutonium-239 concentration in all reservoirs was $<0.32 \times 10^{-9}$ μCi/ml. Samples from locations greater than five miles are felt to be uninfluenced by the plant, and are therefore used as indicators of environmental background levels in water. The MDC for both gross alpha and plutonium in these samples is $<0.01 \times 10^{-9}$ μCi/ml.

Vegetation Sampling Program

Vegetation samples are collected twice yearly from about 40 locations onsite and more than 50 locations outside of the government property. These collections are normally made in June and September each year and are taken over an area of approximately 315 square miles around the plant.

The samples are collected from alongside public rights-of-way and consist primarily of native grasses and volunteer feed grain crops. The root systems of these plants are not collected. The resultant samples are radiochemically analyzed, unwashed, for total plutonium content. All vegetation samples are internally yielded using plutonium-236 and the plutonium content is determined by alpha pulse-height analysis [5]. The MDC for plutonium-239 in these samples is $<0.01 \times 10^{-9}$ μCi/g (dry weight). A summary of these data is shown in Table 15. The annual average concentration of plutonium-239 in vegetation samples was $<0.33 \times 10^{-6}$ μCi/gram (dry).

Soil Sampling Program

Soil samples from uncontrolled property covering a 75 square mile area are collected twice yearly. Samples are routinely collected in June and September from 60 locations lying on the circumferences of three circles having radii of 1, 2, and 5 miles, centered at the plant site. Soil from the top five centimeters is normally collected for plutonium analysis.

The samples are oven dried at 120°C and weighed, homogenized, and sieved to remove the coarser rubble. Ten grams of pulverized soil are prepared for analysis using the method reported by Talvitie [8]. All samples are internally yielded using a plutonium-236 tracer, and the plutonium content is determined by alpha pulse-height analysis. The minimum detectable concentration for plutonium-239 in these samples is $<0.03 \times 10^{-6}$ μCi/g (dry weight).

The results of the soil sampling program are shown in Table 16. Isopleths of plutonium concentrations have been derived by computer analysis of over 300 individual sample results, and are presented in Figure 6. No apparent changes in analytical results were noted from previous years soil analysis [9]. Contour changes appearing in Figure 6 are a result of additional sample results in the computer modeling program and do not reflect movement of plutonium in soil.

REFERENCES

1 *Standards for Radiation Protection*, U S Atomic Energy Commission, AEC Manual, Chapter 0524, 1968

2 *National Emission Standards for Hazardous Air Pollutants*, 40CFR Part 61, Subpart C (Proposed), U S Environmental Protection Agency, 1971

3 *Water Quality Standards and Stream Classification*, Water Pollution Control Commission, Colorado Department of Public Health, 1971

4 D L Bokowski, Rapid Determination of Beryllium by a Direct-Reading Atomic Absorption Spectrometer, *Am Ind Hyg Assoc*, *29*, p 474-481 (1968)

5 *Standard Laboratory Procedures for the Determination of Radioactivity and Chemical Concentrations in Environmental and Bioassay Samples,* D L Bokowski, (ed), RFP-2039, to be published

6 R I Larsen, A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards USEPA, Air Programs Pub AP-89, Supt of Doc , Washington, 1971

7 *Standard Methods for the Examination of Water and Wastewater,* 13th Edition, American Public Health Association, New York, 1971

8 N A Talvitie, *Anal Chem , Vol. 43* No 13, p 1827-1830 (1971)

9 L M Steward and M R Boss, *Annual Report Environmental Safeguard '71,* RFP-ENV-71B, March 10, 1972

TABLES

The values presented herein are composites of many thousands of individual analytical results. Where appropriate, concentration averages which are weighted by volume or weighted by the number of samples are so indicated

Small discrepancies may result between calculations attempted by the reader and the published results because of these weighting or rounding techniques

Table 1 Airborne Effluents Released to Atmosphere During 1972

Measured as Total Long Lived Alpha Emitters

Sample Period	Plutonium Areas (μCi)*	Enriched Uranium Areas (μCi)*	Depleted Uranium Areas (μCi)*	Beryllium Areas (grams)***
Jan	< 1 4	< 39	< 1 9	< 16
Feb	< 4 3	< 63	< 2 5	< 18
Mar	< 2 0	< 92	< 1 9	< 22
Apr	< 2 4	<1 4	< 8 2	<1 2
May	< 3 0	< 79	< 2 8	< 15
Jun	< 2 9	< 95	< 5 0	< 38
Total**	<16	<5 1	<22	<2 3
Jul	< 1 8	< 50	< 3 4	< 24
Aug	<16	< 46	< 2 4	< 37
Sept	< 3 3	< 55	< 4 2	< 41
Oct	< 4 4	< 42	< 5 2	< 25
Nov	< 4 1	< 89	<18	< 37
Dec	<12	< 75	< 9 3	< 32
Total**	<42	<3 6	<42	<2.0

*Reporting of combined average concentrations from a multiplicity of exhaust stacks in a single value is not a correct procedure Only total release values are reported

**Volume weighted total

***The EPA Standard for Beryllium Release is <3650 grams/year

Airborne Effluent Summary – 1972

Area	Effluent Type	Concentration* C_{min}	Concentration* C_{max}	Total Release
Plutonium	Total Long Lived Alpha	<0 002	1 5	<58 μCi
Enriched Uranium	Total Long-Lived Alpha	<0 001	0 027	< 8 7 μCi
Depleted Uranium	Total Long Lived Alpha	<0 001	0 53	<64 μCi
Beryllium	Beryllium	<0 0002	0 054	< 4 3 g

*The total long lived alpha effluent concentrations are expressed in X 10^{-12} μCi/ml, the beryllium concentrations are $\mu g/m^3$

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Table 2 Total Long Lived Alpha Concentrations ±2σ (X 10^{-12} μCi/ml) In Air

Volume Weighted Averages

Community	Jan	Feb	Mar	Apr	May	Jun
Boulder	<0 0066 ± 47%	<0 0106 ±109%	<0 0024 ±1230%	<0 0060 ±1013%	<0 0064 ±73%	<0 0038 ±50%
Broomfield	<0 0068 ±612%	<0 0160 ± 77%	<0 0098 ± 98%	<0 0064 ± 83%	<0 0045 ±13%	<0 0053 ±72%
Coal Creek	<0 0039 ± 56%	<0 0054 ± 64%	<0 0056 ± 18%	<0 0060 ± 63%	<0 0051 ±45%	<0 0049 ±35%
Denver	<0 0047 ± 51%	<0 0070 ± 79%	<0 0054 ± 43%	<0 0081 ± 72%	<0 0071 ±68%	<0 0053 ±77%
Golden	<0 0043 ± 37%	<0 0061 ±118%	<0 0051 ± 29%	<0 0051 ± 4%	<0 0049 ±22%	<0 0074 ±97%
Lafayette	<0 0036 ± 58%	<0 0063 ± 61%	<0 0066 ± 77%	<0 0086 ± 65%	<0 0060 ±47%	<0 0049 ±20%
Marshall	<0 0047 ± 81%	<0 0079 ±138%	<0 0062 ± 82%	<0 0054 ± 9%	<0 0077 ±65%	<0 0047 ±53%
Wagner	<0 0051 ±131%	<0 0036 ± 0%	<0 0043 ± 37%	<0 0045 ± 36%	<0 0039 ±21%	<0 0049 ±49%
Westminster	<0 0049 ± 55%	<0 0070 ± 53%	<0 0054 ± 39%	<0 0075 ± 195%	<0 0047 ±26%	<0 0051 ±43%
Community Average	<0 0048 ± 58%	<0 0070 ± 29%	<0 0050 ± 43%	<0 0064 ± 53%	<0 0056 ±13%	<0 0051 ±14%
Rocky Flats Plant Average	<0 0052 ± 15%	<0 0053 ± 9%	<0 0055 ± 26%	<0 0053 ± 11%	<0 0056 ± 9%	<0 0052 ±11%

January–June 1972 – Summary

Community	n	Vol (m^3)	Conc (X 10^{-12} μCi/ml) C_{min}	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*
Boulder	24	2962 4	<0 0014	0 0693 ±35%	<0 0048 ±139%	<24 0
Broomfield	24	2039 1	<0 0030	0 0491 ±23%	<0 0064 ± 72%	<32 0
Coal Creek	25	2473 1	<0 0030	0 0102 ±27%	<0 0051 ± 15%	<25 5
Denver	25	2408 3	<0 0034	0 0142 ±21%	<0 0062 ± 21%	<31 0
Golden	25	2420 6	<0 0031	0 0139 ±21%	<0 0054 ± 20%	<27 0
Lafayette	25	2403 3	<0 0031	0 0155 ±20%	<0 0059 ± 22%	<29 5
Marshall	25	2427 3	<0 0030	0 0159 ±28%	<0 0058 ± 26%	<29 0
Wagner	22	2692 4	<0 0030	0 0072 ±37%	<0 0046 ± 9%	<23 0
Westminster	23	2242 0	<0 0030	0 0183 ±20%	<0 0057 ± 42%	<28 5
Community Summary	218	22068 0	<0 0014	0 0693 ±35%		
Average					<0 0055 ± 17%	<27 5
Rocky Flats Plant Summary	1481	174869 0	<0 0014	0 0638 ±10%		
Average					<0 0054 ± 6%	< 9 0

*The standard for Pu-239 in air is 0 02 X 10^{-12} μCi/ml for community samples and 0 06 X 10^{-12} μCi/ml for samples taken within the controlled area of the Rocky Flats plant

**Volume weighted average

Volume Weighted Averages

Community	Jul	Aug	Sept	Oct	Nov	Dec
Boulder	<0 0037 ±86%	<0 0054 ± 55%	0 0050 ± 88%	<0 0053 ± 58%	<0 0062 ± 65%	<0 0040 ± 18%
Broomfield	<0 0048 ±44%	<0 0069 ± 88%	0 0021 ± 95%	0 0038 ±606%	<0 0058 ±166%	<0 0055 ± 0%
Coal Creek	<0 0037 ±81%	<0 0044 ± 31%	<0 0068 ±113%	<0 0044 ± 23%	<0 0025 ±128%	<0 0012 ± 67%
Denver	<0 0045 ±69%	0 0073 ±143%	–	0 0097 ±144%	<0 0024 ±433%	<0 0069 ± 87%
Golden	<0 0039 ±72%	<0 0054 ± 8%	<0 0021 ±171%	<0 0068 ± 64%	<0 0049 ±106%	<0 0046 ± 47%
Lafayette	<0 0044 ±47%	<0 0050 ± 5%	<0 0050 ± 68%	<0 0089 ± 82%	<0 0033 ± 94%	<0 0084 ±208%
Marshall	<0 0070 ±53%	<0 0077 ± 61%	<0 0050 ±112%	<0 0053 ± 67%	<0 0055 ± 29%	<0 0056 ± 34%
Wagner	0 0044 ±89%	<0 0063 ±103%	<0 0029 ± 72%	<0 0042 ± 31%	<0 0038 ± 26%	<0 0034 ± 65%
Westminster	<0 0048 ±27%	<0 0059 ± 51%	<0 0049 ±135%	–	<0 0056 ±162%	0 0055 ±823%
Community Average	<0 0045 ±15%	<0 0059 ± 15%	<0 0036 ± 33%	<0 0055 ± 38%	<0 0040 ± 35%	<0 0033 ± 45%
Rocky Flats Average	<0 0059 ± 8%	<0 0054 ± 15%	<0 0080 ± 56%	0 0078 ± 19%	<0 0052 ± 21%	<0 0056 ±127%

Table 2 Total Long-Lived Alpha Concentrations ±2σ (× 10^{-12} μCi/ml) in Air (continued)

July–December 1972 – Summary

Community	n	Vol (m^3)	Conc (× 10^{-12} μCi/ml) C_{min}	C_{max} ±2σ	C^{**}_{avg} ±2σ	% of Standard*
Boulder	26	3451 7	<0 0023	0 0086 ±26%	<0 0049 ±17%	<25 0
Broomfield	22	5190 4	<0 0010	0 0226 ±23%	<0 0034 ±39%	<17 0
Coal Creek	26	5642 9	<0 0008	0 0125 ±22%	<0 0026 ±55%	<13 0
Denver	14	2040 5	<0 0013	0 0121 ±27%	<0 0047 ±55%	<23 5
Golden	25	3040 2	<0 0011	0 0114 ±27%	<0 0041 ±31%	<20 5
Lafayette	24	2689 9	<0 0019	0 0163 ±20%	<0 0055 ±27%	<28 0
Marshall	26	2559 2	<0 0026	0 0116 ±24%	<0 0060 ±15%	<30 0
Wagner	25	3394 2	<0 0019	0 0113 ±24%	<0 0040 ±24%	<20 0
Westminster	16	1672 0	<0 0018	0 0131 ±20%	<0 0054 ±32%	<27 0
Community Summary	204	29681 0	<0 0008	0 0226 ±23%		
Average					<0 0042 ±14%	<21 0
Rocky Flats Plant Summary	1501	180604 0	<0 0014	0 1699 ± 6%		
Average					<0 0063 ±22%	<10 5

*The standard for Pu 239 in air is 0 02 × 10^{-12} μCi/ml for community samples and 0 06 × 10^{-12} μCi/ml for samples taken within the controlled area of the Rocky Flats plant

**Volume weighted average

1972 Summary – Total Long-Lived Alpha Activity in Air

Community	n	Vol (m^3)	Conc (× 10^{-12} μCi/ml) C_{min}	C_{max} ±2σ	C^{**}_{avg} ±2σ	% of Standard*
Boulder	50	6414 1	<0 0014	0 0693 ±35%	<0 0049 ±65%	<24 5
Broomfield	46	7146 5	<0 0010	0 0491 ±23%	<0 0042 ±71%	<21 0
Coal Creek	51	8116 0	<0 0008	0 0125 ±22%	<0 0034 ±26%	<17 0
Denver	39	4448 8	<0 0013	0 0142 ±21%	<0 0056 ±21%	<28 0
Golden	50	5460 8	<0 0011	0 0139 ±21%	<0 0047 ±17%	<23 5
Lafayette	49	5093 2	<0 0019	0 0163 ±20%	<0 0057 ±18%	<28 5
Marshall	51	4986 5	<0 0026	0 0159 ±28%	<0 0059 ±14%	<29 5
Wagner	47	6086 6	<0 0019	0 0113 ±24%	<0 0042 ±14%	<21 0
Westminster	39	3914 0	<0 0018	0 0183 ±20%	<0 0056 ±29%	<28 0
Community Summary	422	51749 5	<0 0008	0 0693 ±35%		
Average					<0 0048 ±13%	<24 0
Rocky Flats Plant Summary	2982	355473 0	<0 0014	0 1699 ± 6%		
Average					<0 0059 ±12%	< 9 8

*The standard for Pu-239 in air is 0 02 × 10^{-12} μCi/ml for community samples and 0 06 × 10^{-12} μCi/ml for samples taken within the controlled area of the Rocky Flats plant

**Volume weighted average

Table 3 Total Long-Lived Beta Activity in Air (X 10^{-12} μCi/ml)

Volume Weighted Averages

Community	Jan	Feb	Mar	Apr	May	Jun
Boulder	<0 4384 ±266%	<0 1381 ±195%	<0 0468 ±698%	<0 1054 ±586%	<0 2211 ±113%	<0 2412 ± 55%
Broomfield	<0 2000 ±335%	<0 2384 ± 68%	<0 1073 ± 96%	<0 1016 ± 91%	<0 1401 ±128%	<0 1204 ± 41%
Coal Creek	0 3076 ±363%	<0 0611 ± 66%	<0 1033 ± 89%	<0 1075 ± 88%	<0 0705 ± 57%	<0 1538 ± 99%
Denver	<0 2462 ±263%	<0 0889 ± 88%	<0 1154 ± 83%	<0 2581 ± 62%	<0 2259 ±179%	<0 1124 ± 78%
Golden	<0 1713 ±271%	<0 1010 ± 25%	<0 0632 ± 34%	<0 3055 ±110%	<0 2464 ± 46%	<0 1688 ± 30%
Lafayette	0 4155 ±274%	<0 0847 ±151%	<0 0894 ± 80%	<0 1247 ±153%	<0 1739 ±226%	<0 1158 ±117%
Marshall	<0 1834 ±256%	<0 1200 ±155%	<0 0657 ±116%	<0 1081 ± 57%	<0 2151 ±129%	<0 0960 ± 19%
Wagner	<0 0461 ±184%	<0 0439 ± 75%	<0 0406 ± 6%	<0 1776 ±430%	<0 0563 ±209%	<0 1373 ± 60%
Westminster	0 3445 ±373%	<0 0834 ± 75%	<0 1253 ±167%	<0 1280 ±345%	<0 3798 ±346%	<0 1406 ± 73%
Community Average	<0 2613 ± 60%	<0 0938 ± 37%	<0 0766 ± 38%	<0 1581 ± 48%	<0 1841 ± 67%	<0 1462 ± 61%
Rocky Flats Average	<1 0964 ± 42%	<0 0944 ± 18%	<0 0739 ± 16%	<0 4512 ± 36%	<0 2637 ± 23%	<0 2204 ± 18%

January–June 1972 – Summary

Community	n	Vol (m^3)	Conc (X 10^{-12} μCi/ml) C_{min}	C_{max} ±2σ	C^{**}_{avg} ±2σ	% of Standard*
Boulder	24	2962 4	<0 0207	1 5317 ±4%	<0 1663 ±109%	<0 50
Broomfield	24	2039 1	<0 0337	0 6623 ±3%	<0 1369 ± 75%	<0 43
Coal Creek	25	2473 1	<0 0472	1 2028 ±4%	<0 1442 ± 72%	<0 44
Denver	25	2408 3	<0 0351	0 8613 ±5%	<0 1803 ± 55%	<0 55
Golden	25	2420 6	<0 0534	0 6630 ±5%	<0 1819 ± 61%	<0 55
Lafayette	25	2403 3	<0 0525	1 4903 ±4%	<0 1797 ± 70%	<0 58
Marshall	25	2427 3	<0 0384	0 6261 ±6%	<0 1336 ± 63%	<0 41
Wagner	22	2692 4	<0 0370	0 6701 ±4%	<0 0937 ± 83%	<0 28
Westminster	23	2242 0	<0 0535	0 9906 ±4%	<0 1948 ± 74%	<0 58
Community Summary	218	22068 5	<0 0207	1 5317 ±4%		
Average					<0 1562 ± 24%	<0 48
Rocky Flats Plant Summary	272	21842 0	<0 0629	7 1393 ±1%		
Average					<0 3411 ± 32%	<0 34

*The standard for total long-lived beta activity in air is 33 X 10^{-12} μCi/ml for community samples and 100 X 10^{-12} μCi/ml for samples taken within the controlled area of the Rocky Flats plant

**Volume weighted average

Volume Weighted Averages

Community	Jul	Aug	Sept	Oct	Nov	Dec
Boulder	<0 1451 ± 52%	<0 1354 ± 59%	<0 0888 ±102%	<0 0550 ± 87%	<0 0614 ± 72%	<0 0610 ± 54%
Broomfield	<0 1187 ±108%	<0 1855 ± 96%	<0 0266 ± 41%	<0 0395 ±350%	<0 0930 ±215%	<0 0627 ± –
Coal Creek	<0 1064 ± 20%	<0 0708 ± 96%	<0 1016 ± 18%	<0 0646 ± 66%	<0 0308 ±110%	<0 0214 ± 66%
Denver	<0 1239 ± 34%	<0 1209 ± 32%	–	<0 0934 ±506%	<0 0191 ±368%	<0 1238 ±548%
Golden	<0 0567 ± 47%	<0 1393 ±198%	<0 0600 ±365%	<0 0994 ± 53%	<0 0965 ±135%	<0 0896 ± 73%
Lafayette	<0 0519 ± 83%	<0 1131 ±145%	<0 0867 ± 30%	<0 1282 ± 73%	<0 0624 ±182%	0 0931 ±227%
Marshall	<0 0673 ± 28%	<0 0983 ± 35%	<0 1193 ± 8%	<0 1112 ± 67%	<0 1142 ±112%	<0 1065 ± 72%
Wagner	<0 0849 ±148%	<0 0742 ± 90%	<0 1125 ±100%	<0 0674 ±145%	<0 0565 ±102%	<0 0430 ± 18%
Westminster	<0 1246 ±484%	<0 1156 ± 69%	<0 0844 ±129%	–	<0 1003 ±225%	<0 0368 ±2019%
Community Average	<0 0974 ± 65%	<0 1163 ± 22%	<0 0637 ± 96%	<0 0727 ± 81%	<0 0600 ±120%	<0 0486 ±111%
Rocky Flats Plant Average	<0 1156 ± 21%	<0 0900 ± 13%	<0 1275 ± 13%	<0 0906 ± 16%	<0 0725 ± 7%	<0 1633 ± 40%

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Table 3 Total Long-Lived Beta Activity in Air ($\times 10^{-12}$ μCi/ml) (continued)

July–December 1972 – Summary

Community	n	Vol (m^3)	Conc ($\times 10^{-12}$ μCi/ml) C_{min}	$C_{max} \pm 2\sigma$	$C_{avg}^{**} \pm 2\sigma$	% of Standard*
Boulder	26	3451 7	<0 0356	0 1815 ± 9%	<0 0912 ± 74%	<0 25
Broomfield	22	5190 4	<0 0203	0 3365 ±11%	<0 0569 ±172%	<0 17
Coal Creek	26	5642 9	<0 0090	0 1312 ±11%	<0 0437 ±112%	<0 14
Denver	14	2040 5	<0 0090	0 1763 ±12%	<0 0658 ±109%	<0 23
Golden	25	3040 2	<0 0130	0 2650 ± 8%	<0 0830 ± 92%	<0 25
Lafayette	24	2689 9	<0 0213	0 2746 ± 8%	<0 0846 ± 78%	<0 26
Marshall	26	2559 2	<0 0532	0 2827 ± 9%	<0 1022 ± 76%	<0 31
Wagner	25	3394 2	<0 0319	0 1943 ± 8%	<0 0731 ± 79%	<0 21
Westminster	16	1672 0	<0 0207	0 3722 ±11%	<0 0917 ±133%	<0 28
Community Summary	204	29681 0	<0 0090	0 3722 ±11%		
Average					<0 0719 ± 32%	<0 22
Rocky Flats Plant Summary	300	24450 0	<0 0629	2 0485 ± 3%		
Average					<0 1118 ± 12%	<0 11

*The standard is 33 X 10^{-12} μCi/ml for total long lived beta activity in air for community samples and 100 X 10^{-12} μCi/ml for samples taken within the controlled area of the Rocky Flats plant

**Volume weighted average

1972 Summary – Total Long Lived Beta Activity in Air

Community	n	Vol (m^3)	Conc ($\times 10^{-12}$ μCi/ml) C_{min}	$C_{max} \pm 2\sigma$	$C_{avg}^{**} \pm 2\sigma$	% of Standard*
Boulder	50	6414 1	<0 0207	1 5317 ±4%	<0 1259 ±75%	<0 37
Broomfield	46	7146 5	<0 0203	0 6623 ±3%	<0 0794 ±90%	<0 24
Coal Creek	51	8116 0	<0 0090	1 2028 ±4%	<0 0739 ±75%	<0 24
Denver	39	4448 8	<0 0090	0 8613 ±5%	<0 1278 ±51%	<0 42
Golden	50	5460 8	<0 0130	0 6630 ±5%	<0 1268 ±52%	<0 39
Lafayette	49	5093 2	<0 0213	1 4903 ±4%	<0 1295 ±54%	<0 42
Marshall	51	4986 5	<0 0384	0 6261 ±6%	<0 1174 ±48%	<0 36
Wagner	47	6086 6	<0 0319	0 6701 ±4%	<0 0885 ±57%	<0 24
Westminster	39	3873 5	<0 0207	0 9906 ±4%	<0 1503 ±64%	<0 45
Community Summary	422	51749 5	<0 0090	1 5317 ±4%		
Average					<0 1078 ±21%	<0 33
Rocky Flats Plant Summary	572	46292 0	<0 0626	7 1393 ±1%		
Average					<0 2200 ±27%	<0 22

*The standard for total long-lived beta activity in air is 33 X 10^{-12} μCi/ml for community samples and 100 X 10^{-12} μCi/ml for samples taken within the controlled area of the Rocky Flats plant

**Volume weighted average

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Table 4 Plutonium Concentrations in Offsite Air Samples, 1972 Averages.

Sampler	$\bar{x}_g$**	σ_g	No of Samples	Max	Min
S-26	066 X − 1 3	2 9	51	84	<Det
S-27	052 X − 1 4	3 6	49	82	
S-28	040 X ÷ 1 5	3 7	46	1 50	
S-29	043 X ÷ 1 6	6 2	52	3 37	
S-30	033 X − 1 4	3 6	47	59	
S-31	049 X ÷ 1 6	5 8	48	3 37	
S-32	064 X − 1 6	5 4	50	1 43	
S-33	065 X − 1 4	3 6	50	1 08	
S-34	060 X ÷ 1 2	1 8	46*	5 74	
S-35	049 X − 1 5	4 4	50	1 01	
S-36	031 X − 1 5	3 6	38	47	
S-37	039 X − 1 4	3 7	47	65	

Units on $\bar{x}_g$ and max are X 10^{-15} μCi/ml, uncertainties are at 95 percent confidence level

σ_g is a factor describing the variability of concentrations observed at one station For S-26 there is a one sigma probability (17 percent chance) that a random value will be larger than (066)X(2 9) or smaller than (066)$\left(\frac{1}{2\ 9}\right)$

Differences in σ_g are not significant at 95 although S-34 is significant at 90

*Station S-34 yielded four samples that were anomalously large compared to the remaining samples However, the truncated group of 46 samples yields the lowest geometric standard deviation observed, suggesting that the four high samples should be regarded as part of the background distribution The five highest of 50 values were 5 74, 2 75, 2 20, 1 72, and 44

**Uncertainty in mean value is commonly expressed as a plus or minus value Denotation of uncertainty takes a different form when log-normal statistics are used The term 0 000044 multiplied or divided by 1 33 means that the limits of uncertainty on the mean value 0 000044 are given by 0 000044 X 1 33 and 0 000044 − 1 33 In this case, and in all other tables and graphs in this section, the factors for uncertainty pertain to 95 percent confidence levels

Table 5 Weekly Average Plutonium Concentrations* Offsite (X10^{-15} μCi/ml)

Date	$\bar{x}_g$	Date	$\bar{x}_g$	Date	$\bar{x}_g$	Date	$\bar{x}_g$
1 3		4 7		7-14		10 20	
	34		023		035		023
1-7		4 14		7 21		10 27	
	27		017		060		035
1-14		4 21		7 28		11 13	
	32		13		093		031
1-21		4-28		8-4		11-10	
	083		034		027		041
1-28		5 5		8 11		11 17	
	29		042		026		017
2 4		5 12		8-18		11-22	
	086		14		010		038
2 11		5-19		8-25		12 1	
	12		028		062		028
2 18		5 26		9 1		12-8	
	23		022		033		042
2 25		6-2		9-8		12 15	
	067		043		064		024
3-3		6 9		9-15		12-20	
	12		042		038		027
3-10		6-16		9 22		12-29	
	13		067		17		
3-17		6-23		9 29			
	19		058		042		
3-25		6-30		10 6			
	042		040		022		
3-30		7 7		10-13			
	086		029		023		
4-7		7 14		10-20			

Year Avg 044 X 10^{-15} μCi/ml The standard for 239 Pu in air is 20 X 10^{-15} μCi/ml

Year-long geometric average was obtained after truncating the distribution below 04 X 10^{-15} μCi/ml

*Geometric average concentrations for 12 stations. All stations yield week-long composite samples Values less than 04 are biased high because they are dominated by analyses that were below the detection limit

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Table 5-A Offsite Plutonium Concentration in Air ±2σ (X 10^{-15} μCi/ml)

Volume Weighted Averages

Location	Jan	Feb	Mar	Apr	May	Jun
S-26	0 34 ± 141%	0 36 ± 94%	<0 22 ±105%	<0 06 ±133%	<0 04 ±200%	0 06 ±100%
S-27	<0 09 ±1270%	<0 19 ±105%	<0 11 ±100%	<0 11 ±218%	<0 09 ± 89%	<0 05 ±100%
S-28	–	<0 13 ±123%	<0 21 ± 95%	<0 05 ± 80%	<0 06 ±117%	<0 42 ±240%
S-29	0 39 ± 113%	<0 97 ±267%	<0 19 ±179%	<0 14 ±136%	<0 06 ±133%	<0 03 ± 33%
S-30	–	<0 07 ±200%	<0 21 ±143%	<0 10 ±100%	<0 07 ±143%	<0 03 ± 33%
S-31	<0 18 ± 106%	0 73 ±130%	<0 23 ±126%	<0 04 ±100%	<0 12 ±158%	0 34 ±259%
S-32	0 31 ± 129%	<0 47 ±202%	<0 20 ±135%	<0 08 ±100%	0 20 ±140%	<0 04 ±200%
S-33	0 25 ± 28%	0 40 ±100%	<0 11 ±227%	<0 04 ±125%	<0 10 ± 80%	<0 06 ± 66%
S-34	<1 77 ± 239%	<0 08 ±112%	0 22 ±100%	<0 06 ±117%	<0 07 ±171%	<0 06 ± 17%
S-35	<0 36 ± 192%	0 30 ±120%	0 16 ± 62%	<0 10 ±150%	<0 03 ± 67%	<0 25 ±148%
S-36	<0 03 ± –	0 20 ±160%	<0 11 ±173%	<0 05 ±140%	<0 04 ±125%	<0 02 ±850%
S-37	–	0 18 ± 78%	<0 44 ± 70%	<0 04 ±100%	<0 07 ±100%	<0 05 ± 80%
Average	0 49 ± 78%	<0 34 ± 53%	<0 20 ± 15%	<0 07 ± 14%	<0 07 ± 14%	<0 14 ± 21%

January–June 1972 – Summary

Location	n	Vol (m^3)	Conc. (X 10^{-15} μCi/ml) C_{min}	C_{max} ±2σ	C_{avg} ±2σ	% of Standard*
S-26	26	133743	<0 01	0 84 ±8%	<0 17 ± 51%	<0 8
S-27	24	73605	<0 02	0 38 ±9%	<0 11 ± 41%	<0 6
S-28	22	132444	<0 01	1 50 ±4%	<0 16 ± 86%	<0 8
S-29	26	101743	<0 02	3 37 ±3%	<0 33 ± 79%	<1 6
S-30	22	80734	<0 02	0 59 ±6%	<0 11 ± 52%	<0 6
S-31	25	98288	<0 02	1 30 ±4%	<0 29 ± 54%	<1 4
S-32	25	103343	<0 02	1 34 ±4%	<0 24 ± 49%	<1 2
S-33	25	93564	<0 02	0 81 ±8%	<0 17 ± 46%	<0 8
S-34	25	96673	<0 01	5 74 ±4%	<0 42 ±121%	<2 1
S-35	26	85359	<0 02	0 99 ±5%	<0 19 ± 50%	<1 0
S-36	22	117374	<0 01	0 47 ±8%	<0 08 ± 69%	<0 4
S-37	21	95031	<0 02	0 65 ±4%	<0 12 ± 52%	<0 6
Summary	289	1211901	<0 01	5 74 ±4%		
Average					<0 20 ± 27%	<1 0

*The soluble plutonium standard is 20 X 10^{-15} μCi/ml to a population group

Volume Weighted Averages

Location	Jul	Aug	Sept	Oct	Nov	Dec
S-26	<0 01 ± 0%	<0 09 ± 56%	<0 07 ±273%	<0 02 ± 0%	<0 06 ± 77%	<0 02 ± 46%
S-27	<0 04 ±375%	<0 08 ±688%	<0 12 ±391%	<0 03 ± 37%	<0 09 ± 79%	<0 21 ±154%
S-28	<0 01 ± 0%	<0 05 ±100%	<0 10 ±130%	<0 01 ± 0%	<0 01 ±124%	<0 01 ± 0%
S-29	<0 05 ± 80%	<0 07 ±126%	<0 07 ±239%	<0 03 ±223%	<0 10 ±208%	<0 12 ±311%
S-30	<0 03 ± 67%	<0 08 ± 76%	<0 03 ±300%	<0 02 ± 20%	<0 07 ±262%	<0 07 ±645%
S-31	<0 05 ± 80%	<0 09 ±351%	<0 05 ± 69%	<0 08 ±163%	<0 05 ±140%	<0 03 ±309%
S-32	<0 06 ±183%	<0 11 ±135%	<0 18 ±223%	<0 29 ±271%	<0 04 ± 82%	<0 50 ±208%
S-33	<0 08 ±325%	<0 05 ±290%	<0 15 ±131%	<0 24 ±314%	<0 05 ±168%	<0 01 ± 0%
S-34	<0 07 ±114%	<0 08 ± 93%	<0 06 ±250%	<0 03 ± 0%	<0 53 ±221%	<0 29 ±494%
S-35	<0 09 ± 89%	<0 06 ± 83%	<0 34 ±216%	<0 02 ± 0%	<0 03 ± 0%	<0 02 ±196%
S-36	–	–	<0 10 ±270%	<0 02 ± 0%	<0 02 ±176%	<0 01 ± 0%
S-37	<0 06 ± 83%	<0 04 ± 50%	<0 11 ±221%	<0 03 ± 53%	<0 05 ±144%	<0 13 ±154%
Average	<0 04 ± 25%	<0 07 ± 51%	<0 11 ± 53%	<0 06 ± 97%	<0 07 ±149%	<0 08 ±126%

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Table 5-A Offsite Plutonium Concentration in Air ±2σ (X 10^{-15} μCi/ml) (continued)

July–December 1972 – Summary

Location	n	Vol (m^3)	Conc (X 10^{-15} μCi/ml) C_{min}	C_{max} ±2σ	C_{avg} ±2σ	% of Standard*
S-26	26	105248	<0 01	0 24 ±12%	<0 05 ± 44%	<0 3
S-27	26	72102	<0 01	0 82 ±17%	<0 10 ± 85%	<0 5
S-28	26	149944	<0 01	0 21 ± 7%	<0 03 ± 64%	<0 2
S-29	26	58218	<0 02	0 48 ± 9%	<0 03 ±182%	<0 2
S-30	25	92901	<0 01	0 53 ± 7%	<0 05 ±102%	<0 2
S-31	23	81548	<0 01	0 24 ±17%	<0 05 ± 61%	<0 2
S-32	25	48551	<0 02	1 43 ± 5%	<0 19 ± 69%	<1 0
S-33	25	88385	<0 01	1 08 ± 4%	<0 10 ± 95%	<0 5
S-34	25	63543	<0 02	2 20 ± 5%	<0 18 ±165%	<0 9
S-35	24	64835	<0 01	1 01 ± 4%	<0 09 ± 96%	<0 4
S-36	16	92204	<0 01	0 22 ± 6%	<0 02 ±150%	<0 1
S-37	26	77090	<0 01	0 32 ± 7%	<0 07 ± 46%	<0 4
Summary Average	293	994569	<0 01	2 20 ± 5%	<0 07 ± 37%	<0 4

*The soluble plutonium standard is 20 X 10^{-15} μCi/ml to a population group

1972 Summary – Offsite Plutonium Concentrations in Air

Volume Weighted Averages

Location	n	Vol (m^3)	Conc (X 10^{-15} μCi/ml) C_{min}	C_{max} ±2σ	C_{avg} ±2σ	% of Standard*
S-26	52	238991	<0 01	0 84 ± 8%	<0 12 ±39%	<0 6
S-27	50	145707	<0 01	0 82 ±17%	<0 11 ±43%	<0 6
S-28	48	282388	<0 01	1 50 ± 4%	<0 09 ±73%	<0 4
S-29	52	159961	<0 02	3 37 ± 3%	<0 22 ±61%	<1 1
S-30	47	173635	<0 01	0 59 ± 6%	<0 08 ±47%	<0 4
S-31	48	179836	<0 01	1 30 ± 4%	<0 18 ±49%	<0 9
S-32	50	151894	<0 02	1 43 ± 5%	<0 22 ±39%	<1 1
S-33	50	181949	<0 01	1 08 ± 4%	<0 14 ±43%	<0 7
S-34	50	160216	<0 01	5 74 ± 4%	<0 32 ±84%	<1 6
S-35	50	150194	<0 01	1 01 ± 4%	<0 15 ±42%	<0 8
S-36	38	209578	<0 01	0 47 ± 8%	<0 05 ±70%	<0 2
S-37	47	172121	<0 01	0 65 ± 4%	<0 10 ±31%	<0 5
Summary Average	582	2206470	<0 01	5 74 ± 4%	<0 14 ±21%	<0 7

*The soluble plutonium standard is 20 X 10^{-15} μCi/ml to a population group

Table 6 Nonradioactive Materials Released in Effluent Water, Annual Averages.

Parameter	Sampling Point A	Sampling Point B-4	Sampling Point C	Standard	Agency
A Physical and Biological					
Color (Pt Co units)	15	25	13	15 Units	USPHS
Turbidity – JT U	0 7	0 8	0 6	5 Units	USPHS
Total Dissolved Solids – mg/l	319 [1]	387 [1]	193 [1]	500	CDH
BOD_5 – mg/l	NA	< 8 7	NA	30 *	CDH
B Chemical					
Sulfate (as SO_4) – mg/l	33 5	76 5	37 0	250	USPHS
Chloride – mg/l	28	57	12	250	USPHS
Chromium (Cr^{+6} as Na_2CrO_4) µg/l	< 5	< 5	< 5	50	USPHS
Cyanide – mg/l	< 0 01	< 0 01	< 0 01	0 01†	USPHS
Fluoride – mg/l	0 87	0 71	0 59	1 0†	USPHS
Arsenic (total) µg/l	< 5 5	< 6 5	< 6 0	10 0	USPHS
Barium (total) µg/l	<100	<100	<100	1000	USPHS
Beryllium (total) µg/l	< 1 5	< 1 3	< 1 8	–	
Cadmium (total) µg/l	< 1 0	< 1 0	< 1 0	10 †	USPHS
Copper (total) µg/l	18	27	15	1000	USPHS
Iron (total) µg/l	25	30	23	300	USPHS
Lead (total) µg/l	9 3	9 5	9 3	50 †	USPHS
Manganese (total) µg/l	9 2	5 5	6 4	50 †	USPHS
Selenium (total) µg/l	< 7 3	< 8 0	< 6 7	10	USPHS
Silver (total) µg/l	< 1 0	< 1 0	< 1 0	50	USPHS
Zinc (total) µg/l	34	49	53	5000 †	USPHS
Phenols µg/l	< 3 5	< 5 0	< 3 5	1 †	USPHS
Surfactants mg/l	< 0 02	0 5	< 0 03	0 5†	USPHS
Nitrate (as NO_3^-) mg/l	35 2	3 5	0 5	45 †	USPHS

[1] Total solids

*The Colorado Water Pollution Control Commission also requires an 80% BOD_5 reduction for facilities having secondary treatment and disinfection

†Units are for drinking water They do not apply to discharge water

Table 7 Radioactivity in Pond (A) Water Samples.

		U + Pu Conc ($\times 10^{-9}$ μCi/ml)			Pu Conc ($\times 10^{-9}$ μCi/ml)		
	n	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$
Jan	3	4 92 ± 9%	8 85 ± 6%	7 15 ± 70%	0 13 ±55%	0 71 ±20%	0 35 ±219%
Feb	4	9 01 ± 6%	12 84 ± 5%	10 30 ± 28%	0 29 ±35%	3 15 ±10%	1 17 ±181%
Mar	5	3 90 ± 9%	16 35 ± 5%	10 29 ± 54%	0 17 ±47%	9 92 ± 6%	2 66 ±192%
Apr	4	5 06 ± 8%	7 94 ± 6%	6 74 ± 33%	0 13 ±53%	0 41 ±30%	0 32 ± 64%
May	5	0 94 ±20%	3 29 ±10%	2 23 ± 47%	0 10 ±65%	0 43 ±35%	0 24 ± 85%
June	4	3 60 ±11%	4 36 ± 9%	4 07 ± 14%	0 47 ±30%	0 92 ±20%	0 73 ± 45%
Summary	25	0 94 ±20%	16 35 ± 5%		0 10 ±65%	9 92 ± 6%	
Average				6 74 ± 23%			0 98 ± 83%
July	4	4 68 ± 9%	6 84 ± 7%	6 02 ± 27%	0 37 ±30%	2 02 ±13%	1 07 ±107%
Aug	5	2 74 ±11%	13 53 ± 5%	7 40 ± 75%	0 42 ±30%	6 17 ± 8%	3 03 ±104%
Sept	4	3 43 ± 6%	19 92 ± 3%	8 89 ±136%	0 34 ±20%	17 61 ± 3%	4 82 ±281%
Oct	3	5 64 ± 5%	19 50 ± 3%	10 75 ±176%	0 73 ±14%	8 80 ± 3%	4 00 ±264%
Nov	3	7 68 ± 4%	24 16 ± 3%	13 29 ±176%	<0 01 ± –	1 81 ± 8%	<0 61 ±422%
Dec	4	5 96 ± 4%	28 62 ± 2%	14 69 ±112%	<0 01 ± –	2 21 ± 8%	<0 93 ±189%
Summary	23	2 74 ±11%	28 62 ± 2%		<0 01 ± –	17 61 ± 3%	
Average				9 89 ± 31%			<2 45 ± 70%
1972 Summary	48	0 94 ±20%	28 62 ± 2%		<0 01 ± –	17 61 ± 3%	
1972 Average				8 17 ± 19%			<1 68 ± 54%
% of Standard*				<0 16%			<0 10%

*The U + Pu soluble standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10{,}000 \times 10^{-9}$ μCi/ml
$RCG_{Pu} = 1667 \times 10^{-9}$ μCi/ml

The soluble plutonium standard is 1667×10^{-9} μCi/ml

**Sample weighted average

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Table 8 Radioactivity in Pond (B 4) Effluent Water Samples.

			U + Pu				Pu			
			Conc ($\times 10^{-9}$ μCi/ml)			Release	Conc ($\times 10^{-9}$ μCi/ml)			Release
	n	Vol (10^6 liters)	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C_{avg}^{**} \pm 2\sigma$	(mCi)	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C_{avg}^{**} \pm 2\sigma$	(mCi)
Jan	4	17 722	8 75 ± 6%	33 54 ±3%	17 33 ±104%	0 307	1 06 ±20%	5 18 ± 2%	3 18 ±114%	0 056
Feb	4	48 831	17 63 ± 5%	38 27 ±3%	26 84 ± 51%	1 311	1 79 ±19%	8 14 ± 7%	5 10 ± 86%	0 249
Mar	5	50 412	11 59 ± 5%	31 12 ±3%	21 28 ± 54%	1 073	2 48 ±14%	3 44 ±11%	2 99 ± 18%	0 151
Apr	4	55 530	9 00 ± 6%	25 33 ±4%	14 88 ± 79%	0 826	1 42 ±17%	16 11 ± 6%	5 71 ±195%	0 317
May	5	46 035	4 50 ± 9%	20 41 ±4%	10 74 ± 71%	0 494	0 85 ±22%	8 97 ± 6%	2 90 ±147%	0 134
Jun	4	65 350	3 06 ± 9%	10 34 ±4%	6 46 ± 75%	0 422	0 66 ±25%	4 56 ±10%	2 22 ±127%	0 145
Summary	26	283 880	3 06 ± 9%	38 27 ±3%		4 433	0 66 ±25%	16 11 ± 6%		1 052
Average					16 24 ± 24%				3 54 ± 38%	
Jul	4	29 232	4 64 ±10%	10 73 ±4%	7 73 ± 66%	0 226	1 13 ± 6%	5 29 ± 9%	2 78 ±113%	0 081
Aug	5	24 121	2 44 ±12%	8 47 ±6%	5 54 ± 70%	0 134	0 48 ±30%	6 94 ± 8%	3 09 ±120%	0 075
Sept	4	31 463	2 80 ± 8%	20 52 ±2%	9 64 ±126%	0 303	0 68 ±14%	15 37 ± 3%	5 05 ±218%	0 159
Oct	1	18 839	(1)	(1)	28 85	0 543	(1)	(1)	18 33	0 345
Nov	4	29 356	57 27 ± 2%	74 52 ±1%	67 20 ± 17%	1 973	34 83 ± 1%	64 78 ± 1%	53 39 ± 28%	1 567
Dec	4	20 968	45 24 ± 2%	134 83 ±1%	88 66 ± 66%	1 859	29 67 ± 2%	123 62 ± 1%	77 44 ± 79%	1 624
Summary	22	153 979	2 44 ±12%	134 83 ±1%		5 038	0 48 ±30%	123 62 ± 1%		3 851
Average					36 54 ± 81%				25 99 ±103%	
1972 Summary	48	437 859	2 44 ±12%	134 83 ±1%		9 471	0 48 ±30%	123 62 ± 1%		4 903
1972 Average					25 29 ± 31%				14 86 ± 79%	
% of Standard*					1 00%				0 89%	

[1] No flow through Pond for three of four weeks

*The U + Pu soluble standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10{,}000 \times 10^{-9}$ μCi/ml, $RCG_{Pu} = 1667 \times 10^{-9}$ μCi/ml

The soluble plutonium standard is 1667×10^{-9} μCi/ml

**Volume weighted average

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Table 9 Radioactivity in Pond (C) Water Samples.

		U + Pu Conc ($\times 10^{-9}$ μCi/ml)			Pu Conc ($\times 10^{-9}$ μCi/ml)		
	n	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C_{avg}^{**} \pm 2\sigma$	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C_{avg}^{**} \pm 2\sigma$
Jan	3	4 37 ±10%	7 77 ± 7%	6 28 ± 69%	0 15 ±50%	0 47 ± 9%	0 27 ±160%
Feb	3	10 52 ± 6%	14 41 ± 5%	12 66 ± 39%	0 49 ±30%	1 79 ±15%	1 07 ±153%
Mar	5	5 69 ± 8%	14 93 ± 5%	9 93 ± 42%	0 07 ±85%	1 57 ±15%	0 77 ±105%
Apr	4	3 85 ±10%	8 83 ± 5%	6 11 ± 56%	0 26 ±40%	1 00 ±20%	0 62 ± 78%
May	5	1 57 ±15%	7 87 ± 7%	4 36 ± 67%	0 23 ±43%	2 08 ±15%	0 77 ±121%
Jun	4	2 01 ±16%	2 97 ±11%	2 46 ± 31%	0 26 ±41%	0 94 ±20%	0 67 ± 90%
Summary	24	1 57 ±15%	14 93 ± 5%		0 07 ±85%	2 08 ±15%	
Average				6 77 ± 25%			0 68 ± 32%
Jul	4	2 71 ±12%	5 14 ± 9%	4 09 ± 48%	0 92 ±19%	2 09 ±15%	1 52 ± 68%
Aug	5	3 01 ±10%	14 61 ± 6%	6 02 ±100%	1 36 ±16%	5 21 ± 9%	2 50 ± 78%
Sept	4	2 10 ± 8%	15 24 ± 3%	5 65 ±180%	0 47 ±16%	12 35 ± 3%	3 48 ±270%
Oct	3	5 66 ± 5%	8 57 ± 4%	7 03 ± 51%	3 02 ± 6%	3 30 ± 7%	3 15 ± 11%
Nov	3	2 06 ± 7%	26 20 ± 2%	11 14 ±293%	<0 01 ± -	2 29 ± 7%	<1 24 ±230%
Dec	4	2 98 ± 6%	15 59 ± 3%	8 12 ±118%	<0 01 ± -	0 88 ±11%	<0 38 ±186%
Summary	23	2 06 ± 7%	26 20 ± 2%		<0 01 ± -	12 35 ± 3%	
Average				6 78 ± 38%			<2 05 ± 54%
1972 Summary	47	1 57 ±15%	26 20 ± 2%		<0 01 ± -	12 35 ± 3%	
1972 Average				6 78 ± 22%			<1 33 ± 42%
% of Standard*				0 13%			0 08%

*The soluble U + Pu standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10{,}000 \times 10^{-9}$ μCi/ml
$RCG_{Pu} = 1667 \times 10^{-9}$ μCi/ml

The soluble plutonium standard is 1667 × 10^{-9} μCi/ml

**Sample Weighted Average

Table 10. Americium Released in Effluent Water from Pond B 4.

		Conc ($\times 10^{-9}$ μCi/ml)			Total Release
	n	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C_{avg} \pm 2\sigma$	(mCi)
Jan	4	0 13	0 81	0 53 ± 90%	0 009
Feb	4	<0 01	1 62	<0 79 ±132%	<0 039
Mar	5	0 22	1 32	0 55 ±100%	0 028
Apr	6	0 56	2 80	1 28 ± 73%	0 071
May	5	0 11	1 86	0 62 ±142%	0 029
Jun	5	0 34	2 51	0 88 ±131%	0 057
Summary	29	<0 01	2 80		<0 227
Average				<0 80 ± 34%	
Jul	4	<0 01	2 69	<0 88 ±223%	<0 026
Aug	4	<0 01	1 69	<0 79 ±151%	<0 019
Sept	4	0 16	1 23	0 74 ±101%	0 023
Oct	1	<0 01	<0 01	<0 01 ±-	<0 0002
Nov	3	3 82	12 94	8 31 ±136%	0 244
Dec	4	15 20	15 38	11 90 ± 61%	0 249
Summary	20	<0 01	15 38		<0 632
Average				<4 11 ± 62%	
1972 Summary	49	<0 01	15 38		<0 941
1972 Average				<2 15 ± 51%	
% of Standard*				<0 07% of Std	

*The soluble americium concentration standard is 1333 × 10^{-9} μCi/ml
**Volume weighted average (volumes from Table 8)

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Table 11 Radioactivity in Walnut Creek Water Samples.

	n	U + Pu Conc ($\times 10^{-9}$ μCi/ml)			Pu Conc ($\times 10^{-9}$ μCi/ml)			Am Conc ($\times 10^{-9}$ μCi/ml)		
		$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$
Jan	3	9 51 ± 6%	11 69 ±6%	10 54 ± 26%	0 53 ±30%	1 18 ±18%	0 82 ±100%	<0 01 ± -	0 21 ±45%	<0 11 ±1155%
Feb	5	14 28 ± 5%	26 83 ±4%	19 49 ± 30%	2 17 ±14%	4 38 ±10%	2 85 ± 39%	<0 01 ± -	0 61 ±25%	<0 33 ± 284%
Mar	7	5 11 ± 9%	29 45 ±4%	19 62 ± 39%	0 64 ±24%	7 45 ± 9%	3 36 ± 63%	<0 01 ± -	4 37 ±10%	<0 29 ± 166%
Apr	4	11 53 ± 9%	34 70 ±3%	17 65 ±102%	0 91 ±21%	3 37 ±11%	2 05 ± 79%	0 39 ±32%	0 72 ±25%	0 56 ± 356%
May	6	2 99 ±11%	22 68 ±3%	9 11 ± 80%	0 34 ±30%	3 46 ±11%	1 62 ± 68%	NS	NS	–
Jun	4	3 64 ±11%	7 02 ±8%	5 14 ± 50%	0 82 ±17%	1 56 ±20%	1 06 ± 52%	NS	NS	–
Summary	29	2 99 ±11%	34 70 ±3%		0 34 ±30%	7 45 ± 9%		<0 01 ± -	4 37 ± 8%	
Average				14 22 ± 23%			2 15 ± 28%			<0 30 ± 110%
Jul	3	3 12 ±10%	7 93 ±7%	5 59 ±107%	0 28 ±30%	3 71 ±10%	1 58 ±163%	<0 01 ± -	1 13 ± 9%	<0 57 ±1249%
Aug	5	3 56 ±10%	5 45 ±9%	4 19 ± 22%	1 17 ±19%	2 93 ±11%	1 86 ± 49%	<0 01 ± -	1 16 ± 9%	<0 67 ± 119%
Sept	4	2 63 ± 8%	24 30 ±2%	10 08 ±154%	1 00 ±11%	20 40 ± 3%	6 70 ±219%	0 33 ±36%	0 62 ±20%	0 46 ± 76%
Oct	3	11 33 ± 3%	72 33 ±1%[1]	41 74 ±181%	3 61 ± 6%	23 30 ± 2%[1]	13 20 ±185%	–	–	4 83 ± -[2]
Nov	3	15 15 ± 3%	113 09 ±1%	48 59 ±285%	7 67 ± 4%	108 77 ±12%	42 69 ±129%	1 90 ±14%	3 89 ±12%	2 90 ± 147%
Dec	4	28 30 ± 3%	65 15 ±1%	42 51 ± 64%	19 61 ± 3%	48 40 ± 2%	29 64 ± 74%	1 69 ±15%	7 52 ± 7%	4 09 ± 66%
Summary	22	2 63 ± 8%	113 09 ±1%		0 28 ±30%	108 77 ±12%		<0 01 ± -	7 52 ± 7%	
Average				23 59 ± 54%			16 56 ± 63%			<2 13 ± 53%
1972 Summary	51	2 63 ± 8%	113 09 ±1%		0 28 ±30%	108 77 ±12%		<0 01 ± -	7 52 ± 7%	
1972 Average				18 26 ± 31%			8 82 ± 57%			<1 01 ± 51%
% of Standard*				0 62%			0 53%			<0 08%

[1] No flow in Walnut Creek

[2] Only one sample taken for Am analysis

*The soluble U + Pu standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10{,}000 \times 10^{-9}$ μCi/ml, $RCG_{Pu} = 1667 \times 10^{-9}$ μCi/ml

The soluble plutonium standard is 1667×10^{-9} μCi/ml

The soluble americium standard is 1333×10^{-9} μCi/ml

**Sample weighted average

NS – No Sample Taken

Table 12. Summary of Radioactivity in Reservoir and Tap Water Sources.

January–June 1972 – Summary

Reservoir	n	U + Pu Conc ($\times 10^{-9}$ μCi/ml) $C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*	Pu Conc ($\times 10^{-9}$ μCi/ml) $C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*
Baseline	3	0 58 ±5%	1 45 ±3%	0 95 ±118%	0 01	<0 01 ± -	0 13 ±11%	<0 07 ±213%	<0 01
Great Western	12	2 59 ±2%	8 81 ±1%	4 32 ± 29%	0 06	0 08 ±13%	1 16 ± 4%	0 28 ± 71%	0 02
Ralston	12	3 64 ±1%	25 77 ±1%	10 22 ± 43%	0 13	0 03 ±18%	1 86 ± 2%	0 52 ±118%	0 03
Standley	12	2 93 ±1%	7 23 ±1%	5 22 ± 54%	0 07	0 04 ±17%	0 73 ± 5%	0 28 ± 50%	0 02
Summary	39	0 58 ±5%	25 77 ±1%			<0 01 ± -	1 86 ± 2%		
Average				6 15 ± 28%	0 08			<0 34 ± 50%	<0 02
Tap Water Source									
Arvada	12	0 70 ±5%	6 33 ±1%	2 39 ± 50%	0 04	<0 01 ± -	1 61 ± 3%	<0 35 ± 87%	<0 02
Boulder	12	0 53 ±5%	2 78 ±3%	1 56 ± 43%	<0 03	<0 01 ± -	1 25 ± 4%	<0 28 ± 77%	<0 02
Broomfield	12	1 36 ±2%	5 03 ±1%	3 02 ± 28%	0 05	0 08 ±11%	0 81 ± 3%	0 32 ± 50%	<0 02
Denver	12	0 38 ±6%	13 68 ±1%	5 22 ± 52%	0 08	0 04 ± 4%	4 29 ± 2%	0 63 ±125%	0 04
Golden	12	0 57 ±6%	(30 30 ±1%)[1]	5 67 ± 96%	<0 09	<0 01 ± -	3 07 ± 2%	<0 59 ± 94%	<0 04
Lafayette	12	0 53 ±5%	8 02 ±1%	1 87 ± 73%	<0 04	<0 01 ± -	2 10 ± 3%	<0 37 ± 97%	<0 02
Louisville	12	0 73 ±4%	5 24 ±1%	1 94 ± 52%	0 04	0 10 ±31%	1 91 ± 3%	0 38 ± 80%	0 02
Thornton	11	3 95 ±2%	39 87 ±1%	14 52 ± 58%	<0 17	<0 01 ± -	2 10 ± 4%	<0 42 ± 92%	<0 03
Westminster	11	0 66 ±4%	5 11 ±1%	2 11 ± 41%	0 03	<0 01 ± -	0 58 ± 4%	<0 27 ± 39%	<0 02
Summary	106	0 38 ±6%	39 87 ±1%			<0 01 ± -	4 29 ± 2%		
Average				4 18 ± 28%	<0 06			<0 40 ± 28%	<0 02

[1] Suspect Data Significantly high value compared to average and previous year values

*The soluble U+ Pu standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10{,}000 \times 10^{-9}$ μCi/ml, $RCG_{Pu} = 1667 \times 10^{-9}$ μCi/ml

The soluble plutonium standard is 1667×10^{-9} μCi/ml

**Sample weighted average

July–December 1972 – Summary

Reservoir	n	U + Pu Conc ($\times 10^{-9}$ μCi/ml) $C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*	Pu Conc ($\times 10^{-9}$ μCi/ml) $C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*
Baseline	11	<0 01 ± -	18 69 ±1%	<4 62 ±102%	<0 07	<0 01 ± -	2 22 ±3%	<0 55 ± 87%	<0 03
Great Western	11	1 11 ±3%	9 25 ±1%	4 26 ± 44%	<0 10	<0 01 ± -	6 42 ±1%	1 09 ±115%	<0 07
Ralston	11	0 94 ±3%	12 15 ±1%	4 37 ± 58%	0 06	<0 01 ± -	1 77 ±3%	<0 36 ±100%	<0 02
Standley	9	2 52 ±1%	7 47 ±1%	4 14 ± 36%	0 06	<0 01 ± -	0 95 ±4%	<0 40 ± 71%	<0 02
Summary	42	<0 01 ± -	18 69 ±1%			<0 01 ± -	6 42 ±1%		
Average				<4 36 ± 31%	<0 07			<0 61 ± 55%	<0 04
Tap Water Source									
Arvada	11	<0 01 ± -	3 31 ±3%	<1 18 ± 53%	<0 03	<0 01 ± -	1 28 ±3%	<0 40 ± 81%	<0 02
Boulder	11	<0 01 ± -	2 60 ±2%	<1 23 ± 46%	<0 04	<0 01 ± -	1 23 ±3%	<0 47 ± 67%	<0 03
Broomfield	11	<0 01 ± -	7 13 ±2%	<2 27 ± 67%	<0 05	<0 01 ± -	2 85 ±3%	<0 61 ± 91%	<0 04
Denver	10	0 77 ±3%	4 26 ±1%	2 37 ± 41%	0 05	<0 01 ± -	2 36 ±1%	<0 61 ± 73%	<0 04
Golden	11	0 24 ±5%	5 50 ±2%	2 26 ± 44%	0 04	<0 01 ± -	1 60 ±3%	<0 36 ± 88%	<0 02
Lafayette	10	0 26 ±5%	2 22 ±3%	0 91 ± 65%	<0 04	<0 01 ± -	2 73 ±3%	<0 59 ± 93%	<0 04
Louisville	11	0 53 ±6%	6 44 ±1%	2 01 ± 62%	<0 04	<0 01 ± -	1 67 ±2%	<0 34 ±103%	<0 02
Thornton	9	1 05 ±3%	11 65 ±1%	5 03 ± 56%	<0 10	<0 01 ± -	3 04 ±1%	<0 95 ± 85%	<0 06
Westminster	11	0 70 ±5%	7 43 ±1%	2 17 ± 67%	0 05	<0 01 ± -	2 09 ±3%	<0 62 ± 77%	<0 04
Summary	95	<0 01 ± -	11 65 ±1%			<0 01 ± -	3 04 ±1%		
Average				<2 11 ± 20%	<0 05			<0 54 ± 27%	<0 03

*The soluble U + Pu standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10\,000 \times 10^{-9}$ μCi/ml, $RCG_{Pu} = 1667 \times 10^{-9}$ μCi/ml

The soluble plutonium standard is 1667×10^{-9} μCi/ml

**Sample weighted average

Table 12. Summary of Radioactivity in Reservoir and Tap Water Sources (continued)

1972 Summary

Reservoir	n	U + Pu Conc ($\times 10^{-9}$ µCi/ml) $C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*	Pu Conc ($\times 10^{-9}$ µCi/ml) $C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard*
Baseline	14	<0 01 ± -	18 69 ±1%	<3 83 ±96%	<0 06	<0 01 ± -	2 22 ±3%	<0 44 ±87%	<0 03
Great Western	23	1 11 ±2%	9 25 ±1%	4 29 ±23%	<0 08	<0 01 ± -	6 42 ±1%	<0 67 ±88%	<0 04
Ralston	23	0 94 ±2%	25 77 ±1%	7 43 ±36%	<0 10	<0 01 ± -	1 86 ±2%	<0 44 ±71%	<0 03
Standley	21	2 52 ±1%	7 47 ±1%	4 76 ±33%	0 06	<0 01 ± -	0 95 ±4%	<0 34 ±40%	<0 02
Summary	81	0 01 ± -	25 77 ±1%			<0 01 ± -	6 42 ±1%		
Average				<5 22 ±21%	<0 08			<0 48 ±39%	<0 03
Tap Water Source									
Arvada	23	<0 01 ± -	6 33 ±1%	<1 81 ±37%	<0 04	<0 01 ± -	1 61 ±3%	<0 38 ±52%	<0 02
Boulder	23	<0 01 ± -	2 78 ±3%	<1 40 ±29%	<0 03	<0 01 ± -	1 25 ±4%	<0 37 ±47%	<0 02
Broomfield	23	<0 01 ± -	7 13 ±2%	<2 67 ±29%	<0 05	<0 01 ± -	2 85 ±3%	<0 46 ±61%	<0 03
Denver	22	0 38 ±6%	13 68 ±1%	3 92 ±39%	0 07	<0 01 ± -	4 29 ±2%	<0 62 ±67%	<0 04
Golden	23	0 24 ±5%	(30 30 ±1%)[1]	4 04 ±66%	0 06	<0 01 ± -	3 07 ±2%	<0 48 ±61%	<0 03
Lafayette	22	0 26 ±5%	8 02 ±1%	1 43 ±50%	<0 04	<0 01 ± -	2 73 ±3%	<0 48 ±62%	<0 03
Louisville	23	0 53 ±6%	6 44 ±1%	1 97 ±37%	<0 04	<0 01 ± -	1 91 ±3%	<0 36 ±59%	<0 02
Thornton	20	1 05 ±3%	39 87 ±1%	10 25 ±48%	<0 14	<0 01 ± -	3 04 ±1%	<0 66 ±60%	<0 04
Westminster	22	0 66 ±4%	7 43 ±1%	2 14 ±36%	0 04	<0 01 ± -	2 09 ±3%	<0 45 ±52%	<0 03
Summary	201	<0 01 ± -	39 87 ±1%			<0 01 ± -	4 29 ±2%		
Average				<3 20 ±21%	<0 05			<0 31 ±21%	<0 02

[1] Suspect data Significantly high value compared to average and previous year values

*The soluble U + Pu standard is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} \leq 1$ Where $RCG_U = 10\,000 \times 10^{-9}$ µCi/ml, $RCG_{Pu} = 1667 \times 10^{-9}$ µCi/ml

The soluble plutonium standard is 1667×10^{-9} µCi/ml

**Sample weighted average

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Table 13 Americium Concentrations in Reservoir Water Samples.

		January to June 1972 Conc ($\times 10^{-9}$ µCi/ml)				July to December 1972 Conc ($\times 10^{-9}$ µCi/ml)		
Reservoir	n	C_{min}	C_{max}	$C^{**}_{avg} \pm 2\sigma$	n	C_{min}	C_{max}	$C^{**}_{avg} \pm 2\sigma$
Great Western	9	<0 03	1 23	0 36 ± 95%	9	<0 01	1 43	<0 40 ± 94%
Standley	7	<0 01	0 42	<0 12 ±112%	5	<0 01	0 78	<0 218 ±191%
Summary	16	<0 01	1 23		14	<0 01	1 43	
Average				<0 255 ± 74%				<0 334 ± 75%

Americium Concentrations in Reservoirs – 1972

		Conc ($\times 10^{-9}$ µCi/ml)			
Reservoir	n	C_{min}	C_{max}	$C^{**}_{avg} \pm 2\sigma$	% of Standard*
Great Western	18	<0 01	1 43	<0 38 ±59%	<0 028
Standley	12	<0 01	0 78	<0 16 ±92%	<0 012
Summary	30	<0 01	1 43		
Average				<0 29 ±50%	<0 022

*The soluble americium standard is 1333 X 10^{-9} µCi/ml

**Sample weighted average

Table 14 Radioactivity in Surrounding Lakes, Reservoirs, and Streams.

June 1972

		U + Pu Conc ($\times 10^{-9}$ µCi/ml)			Pu Conc ($\times 10^{-9}$ µCi/ml)		
Location	n	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$
<5 Miles	11	1 18 ±3%	6 90 ±1%	3 34 ± 42%	<0 01 ± -	1 17 ±4%	<0 24 ±91%
>5 Miles	14	0 60 ±5%	99 84 ±1%	14 62 ±108%	<0 01 ± -	0 27 ±5%	<0 08 ±64%
Summary	25	0 60 ±5%	99 84 ±1%		<0 01 ± -	1 17 ±4%	
Average				9 66 ± 89%			<0 15 ±64%

September 1972

		U + Pu Conc ($\times 10^{-9}$ µCi/ml)			Pu Conc ($\times 10^{-9}$ µCi/ml)		
Location	n	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$
<5 Miles	15	0 32 ±7%	11 65 ±1%	2 25 ±72%	<0 01 ± -	6 33 ±2%	<0 54 ±165%
>5 Miles	16	0 16 ±9%	79 22 ±1%	15 20 ±82%	<0 01 ± -	1 25 ±3%	<0 37 ± 52%
Summary	31	0 16 ±9%	79 22 ±1%		<0 01 ± -	6 33 ±2%	
Average				8 93 ±74%			<0 45 ± 91%

Summary 1972

		U + Pu Conc ($\times 10^{-9}$ µCi/ml)				Pu Conc ($\times 10^{-9}$ µCi/ml)			
Location	n	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard	$C_{min} \pm 2\sigma$	$C_{max} \pm 2\sigma$	$C^{**}_{avg} \pm 2\sigma$	% of Standard
<5 Miles	26	0 32 ±7%	11 65 ±1%	2 71 ±40%	<0 05	<0 01 ± -	6 33 ±2%	<0 41 ±120%	<0 03
>5 Miles	30	0 16 ±9%	99 84 ±1%	14 93 ±62%	<0 16	<0 01 ± -	1 25 ±3%	<0 24 ± 48%	<0 01
Summary	56	0 16 ±9%	99 84 ±1%			<0 01 ± -	6 33 ±2%		
Average				9 26 ±55%	<0 11			<0 32 ± 72%	<0 02

*The soluble standard for a mixture of U + Pu is $\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} < 1$ Where $RCG_U = 10{,}000 \times 10^{-9}$ µCi/ml, $RCG_{Pu} = 1667 \times 10^{-9}$ µCi/ml

The soluble plutonium standard is 1667 X 10^{-9} µCi/ml

**Sample weighted average

Table 15 Plutonium in Vegetation Samples

Location	June 1972 n	Pu Conc [X 10^{-6} μ Ci/g(dry)] C_{min} ±2σ	C_{max} ±2σ	C^*_{avg} ±2σ	September 1972 n	Pu Conc [X 10^{-6} μCi/g(dry)] C_{min} ±2σ	C_{max} ±2σ	C^*_{avg} ±2σ
<1 Mile	40	<0 01 ± -	3 11 ±3%	<0 39 ±55%	58	0 05 ±14%	4 14 ±8%	0 48 ±34%
1-5 Miles	29	<0 01 ± -	1 23 ±4%	<0 12 ±92%	47	0 03 ±12%	2 71 ±3%	0 31 ±44%
>5 Miles	20	<0 01 ± -	1 05 ±4%	<0 22 ±66%	21	0 02 ±13%	1 04 ±9%	0 20 ±50%
Summary	89	<0 01 ± -	3 11 ±4%		126	0 02 ±12%	4 14 ±8%	
Average				<0 26 ±41%				0 37 ±26%

Location	1972 Summary n	Pu Conc [X 10^{-6} μCi/g(dry)] C_{min} ±2σ	C_{max} ±2σ	C^*_{avg} ±2σ
<1 Mile	98	<0 01 ± -	4 14 ±8%	<0 44 ±30%
1-5 Miles	76	<0 01 ± -	2 71 ±3%	<0 24 ±42%
>5 Miles	41	<0 01 ± -	1 05 ±4%	<0 21 ±41%
Summary	215	<0 01 ± -	4 14 ±8%	
Average				<0 33 ±22%

*Sample weighted average

Table 16 Plutonium Concentrations in Soil Samples from Around the Rocky Flats Plant [d/m/g (dry weight)]

1 Mile Location	n	C_{avg} ±2σ	2 Mile Location	n	C_{avg} ±2σ	5 Mile Location	n	C_{avg} ±2σ
1 000	6	0 58 ± 97%	2-000	6	0 53 ±160%	5 000	6	0 35 ± 92%
1 018	6	0 34 ± 46%	2 018	6	2 04 ±195%	5-018	6	0 44 ±115%
1 036	7	0 40 ± 87%	2 036	5	1 03 ±129%	5-036	–	–
1 054	7	1 16 ±133%	2 054	6	0 62 ± 67%	5-054	6	0 46 ± 82%
1 072	6	1 12 ±112%	2-072	6	0 85 ± 98%	5 072	6	0 39 ± 95%
1 090	6	21 62 ± 96%	2 090	6	11 66 ± 94%	5-090	6	0 46 ± 46%
1 108	6	48 09 ± 67%	2 108	6	1 89 ± 82%	5-108	3	0 93 ±140%
1 126	6	20 04 ±126%	2 126	6	6 05 ±205%	5 126	7	0 31 ± 69%
1 144	6	2 52 ±104%	2 144	6	0 69 ±103%	5 144	4	0 43 ± 94%
1 162	5	2 00 ±193%	2 162	7	0 39 ± 59%	5 162	5	0 90 ±188%
1 180	5	0 19 ±112%	2 180	7	0 41 ± 66%	5-180	4	2 16 ±157%
1 198	5	0 56 ± 36%	2 198	7	0 88 ± 98%	5 198	–	–
1 216	5	0 36 ± 51%	2 216	6	0 77 ±124%	5 216	5	0 65 ± 66%
1-234	6	1 36 ±117%	2 234	5	1 65 ±214%	5 234	7	0 54 ± 67%
1-252	6	0 94 ± 82%	2 252	6	1 25 ±128%	5-252	7	0 46 ± 78%
1 270	5	0 45 ±151%	2 270	5	0 73 ± 93%	5 270	7	0 97 ± 60%
1 288	6	0 61 ±144%	2 288	4	0 41 ±160%	5-288	–	–
1 306	1	0 68 ± -	2-306	6	0 48 ± 51%	5-306	5	0 69 ±136%
1-324	5	0 71 ±114%	2 324	6	0 43 ± 67%	5-324	3	0 38 ±270%
1-342	6	3 70 ±229%	2-342	5	0 32 ±135%	5 342	7	0 71 ± 90%

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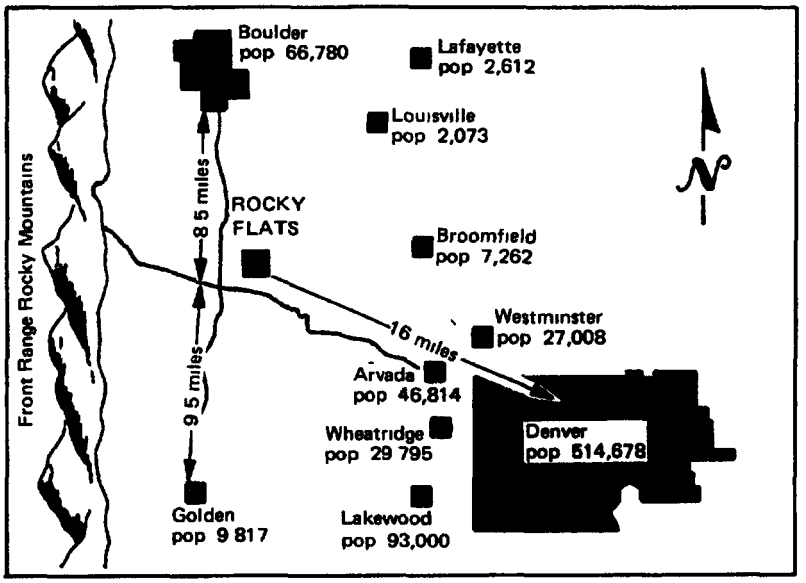
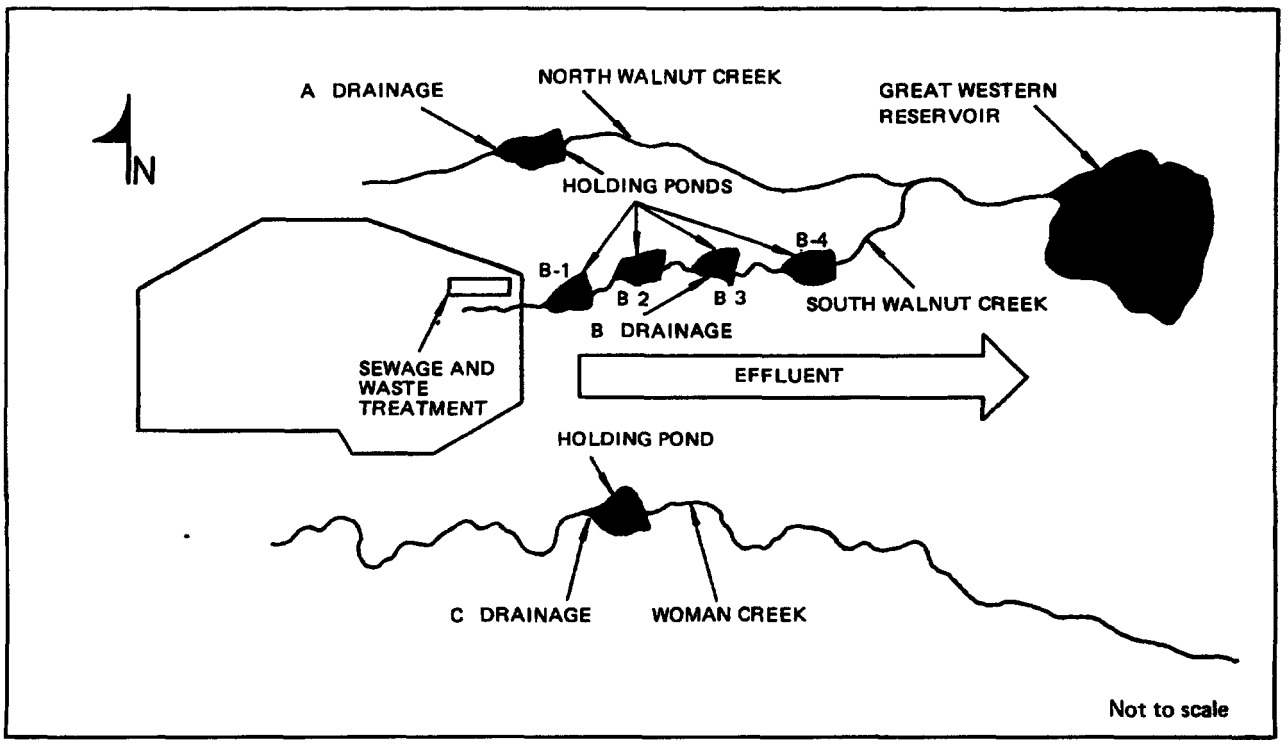


Figure 1 Rocky Flats Area

Figure 2 Liquid Effluent Water Courses



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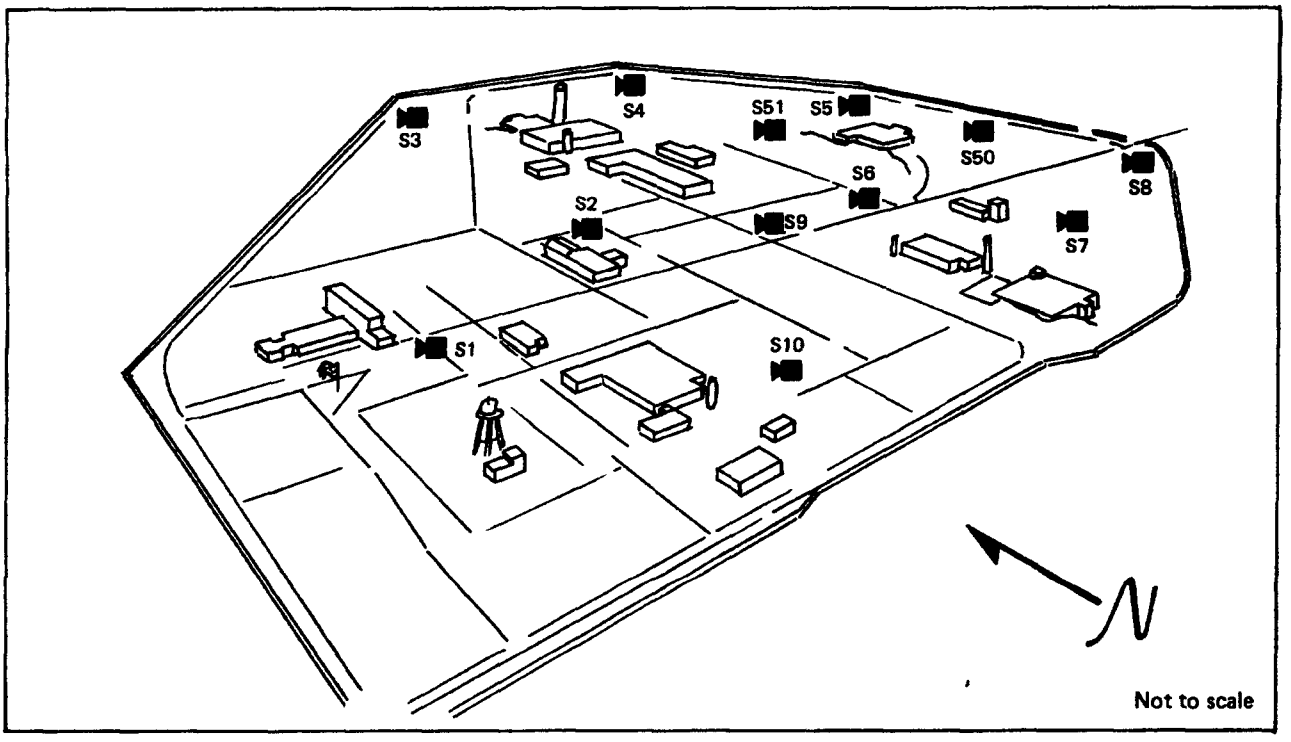

Figure 3 Rocky Flats Onsite Air Samplers

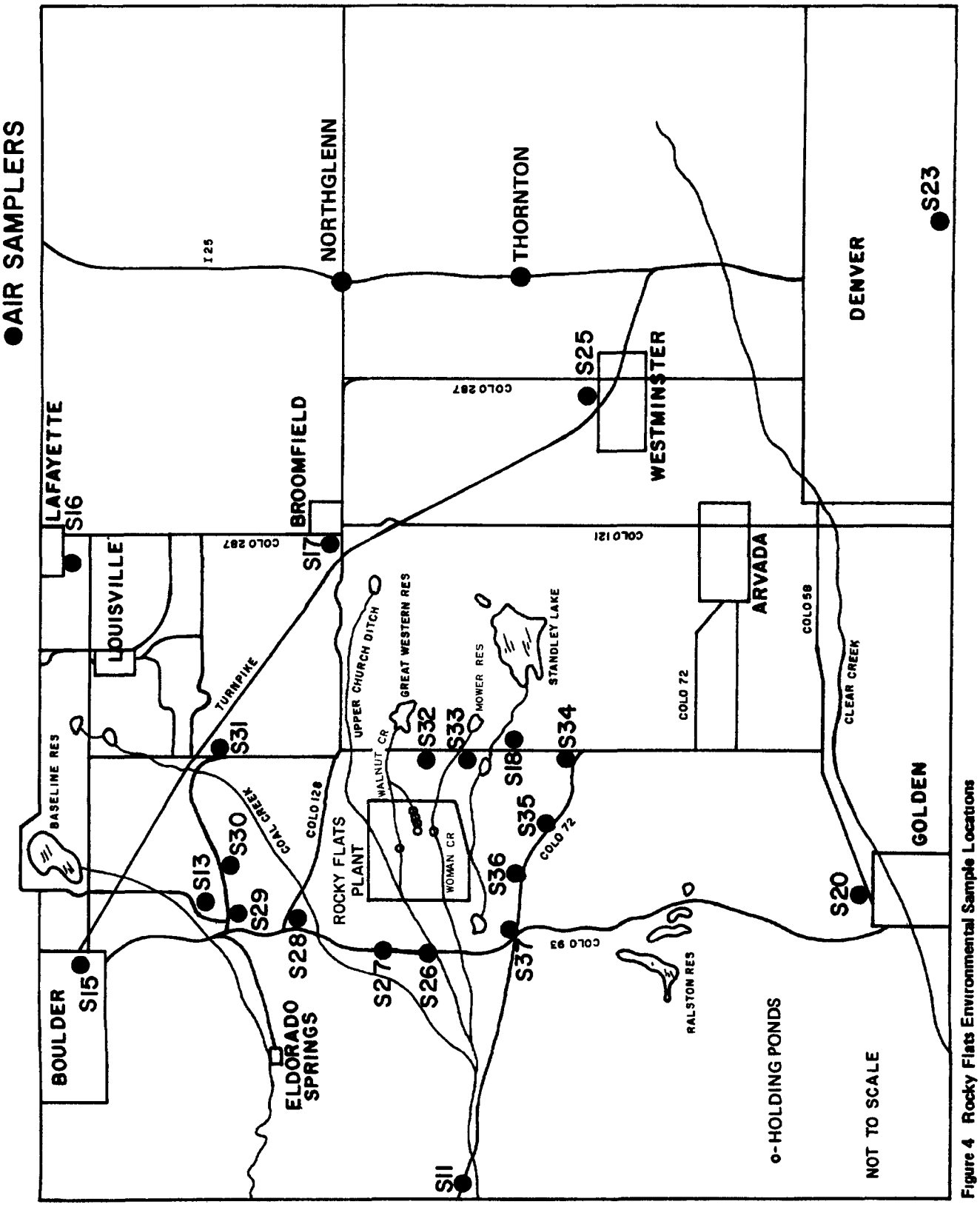

Figure 4 Rocky Flats Environmental Sample Locations

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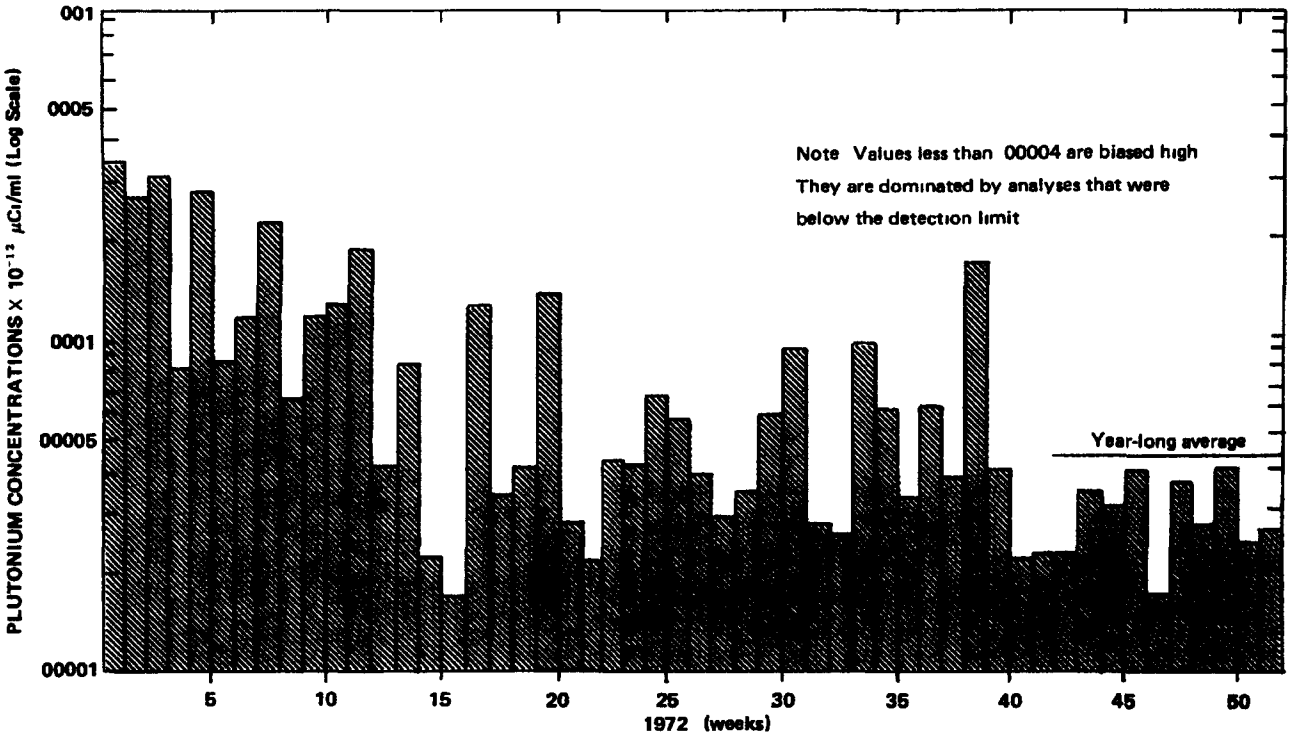

Figure 5 Weekly Average Plutonium Concentrations in Air, Offsite Geometric Average Concentrations for 12 Stations (S-26 through S-37)

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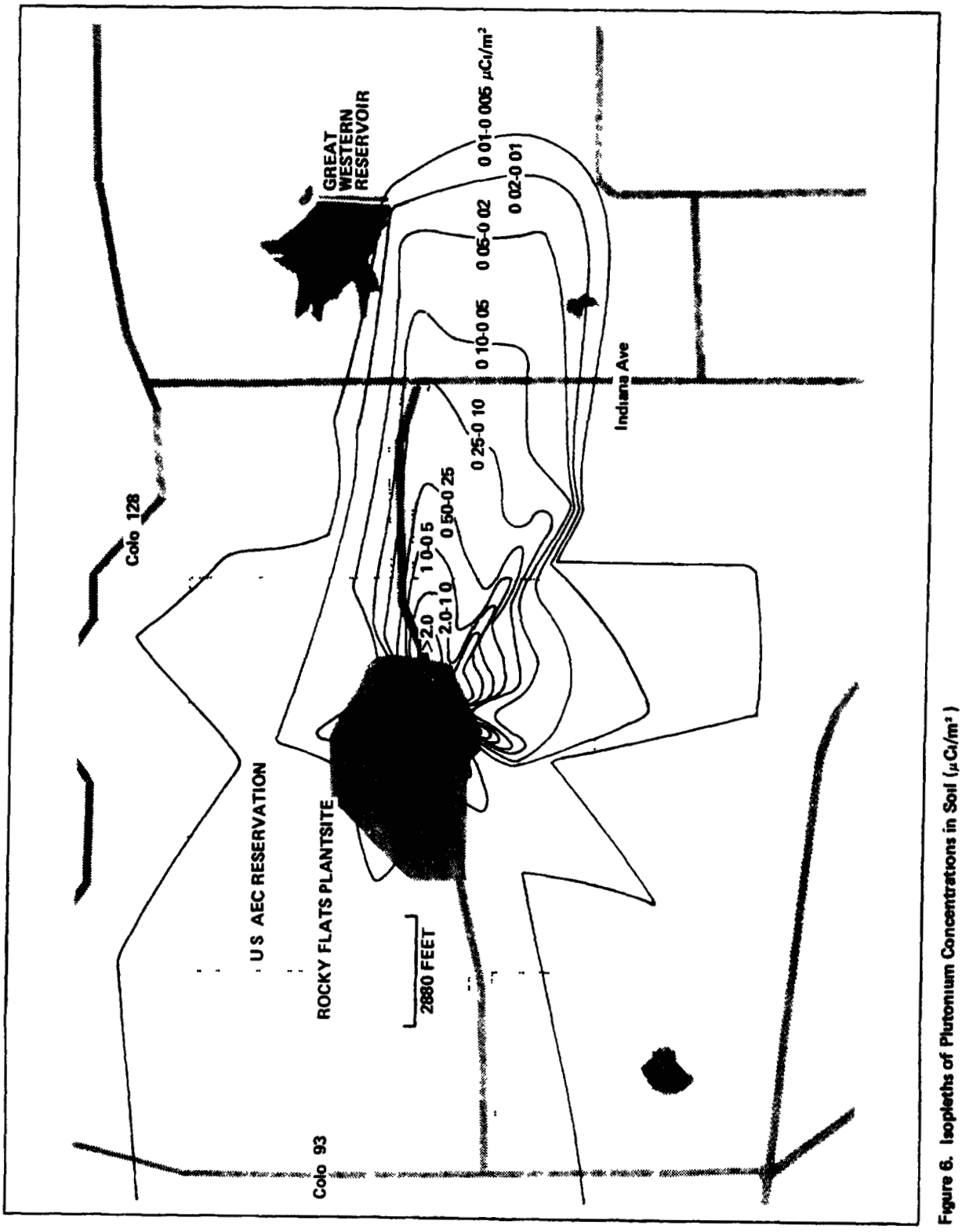

Figure 6. Isopleths of Plutonium Concentrations in Soil ($\mu Ci/m^2$)

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SUMMARY
ANNUAL ENVIRONMENTAL MONITORING REPORT ROCKY FLATS PLANT

January through December 1972

April 13, 1973

The Annual Environmental Monitoring Report of the Rocky Flats Plant was prepared for the U S Atomic Energy Commission under Contract AT(29-1)-1106 Copies of the full report (RFP-ENV-72) are available from the Information Department, Rocky Flats Division, Dow Chemical U S A , Post Office Box 888, Golden, Colorado 80401

The following is a summary of RFP-ENV-72

The Rocky Flats Plant rountinely handles quantities of radioactive material (uranium and plutonium), as well as nonradioactive toxic materials, notably beryllium

Environmental considerations are a basic part of the operating philosophy at the Rocky Flats Plant Background radioactivity measurements were performed as early as 1951, and environmental programs have been continually expanded with improved technological capabilities and awareness

Analytical results from over 60,000 environmental samples in 1972 disclosed that the yearly average of plutonium concentrations in air and water in the plant environs was less than 2% of the established guidelines Analyses of other materials in effluent water as required by Colorado and U S regulations were below the most restrictive guidelines or limits for waste-water discharges

Results of the environmental sampling program are reported monthly to the U S Environmental Protection Agency and to the Colorado Department of Health The independent

analyses performed by these agencies show no significant difference from those of Rocky Flats

ROCKY FLATS MONITORING PROGRAM

Air

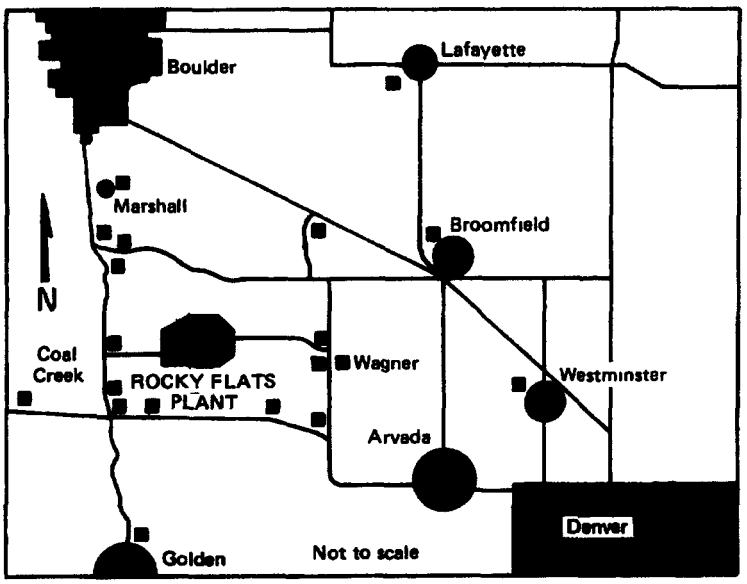
Air samples are taken at the point-of-discharge from all buildings handling toxic materials These samples are analyzed to determine the concentrations of long-lived alpha emitters and beryllium Twelve continuously operating air samplers are located on the plant In addition, 12 high-volume samplers surround the plant at about a 2 to 4-mile radius Also, air samplers which sample for 10 minutes out of each hour are located in Boulder, Broomfield, Golden, Westminster, Denver, Lafayette, Marshall, at the east entrance to Coal Creek Canyon and at the Wagner Site (2 5 miles southeast of the plant) (see Map 1) The samples from the community and onsite samplers are analyzed for total long-lived alpha concentrations * The samples from the high-volume samplers (offsite) are analyzed specifically for plutonium concentrations

Beryllium concentrations are measured at community and onsite sampling stations

Water

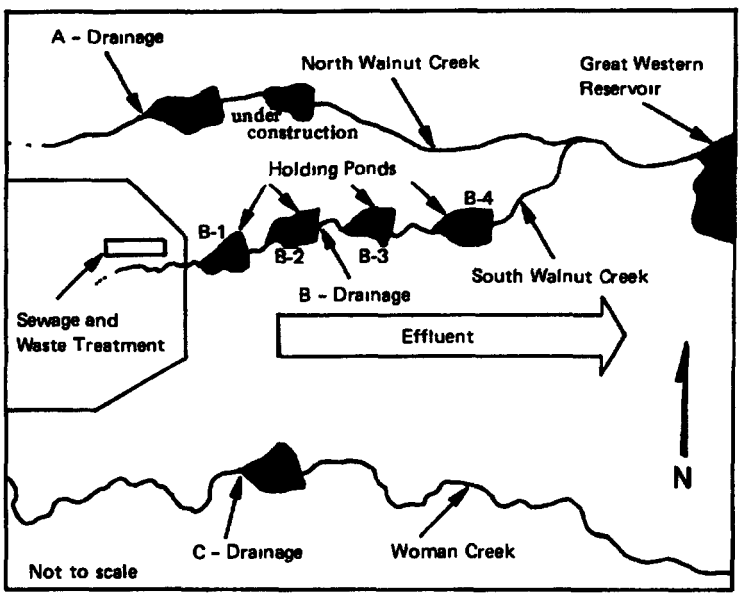
The Rocky Flats Plant site is drained by three systems North Walnut Creek, South Walnut Creek, and Woman Creek North Walnut Creek and Woman Creek each have one holding pond where as South Walnut Creek has four holding ponds A second pond is being constructed on North Walnut Creek and the capacity of all the ponds is being increased (see Map 2) These holding ponds are designed to provide

*Total long-lived alpha includes natural and fallout alpha activity



Map 1 Location of Environmental Samplers

Map 2 Rocky Flats Drainage System



resident settling time for discharges and water retention capability

Treated process and sanitary wastes are discharged to South Walnut Creek Cooling tower waters are discharged to North Walnut Creek and Woman Creek

Samples from the discharge of the last pond on South Walnut Creek and from below the confluence of North and South Walnut Creeks at Indiana Street are analyzed daily for radioactivity

Water from the ponds located on North Walnut Creek and Woman Creek, and the final pond on South Walnut Creek, are sampled daily and analyzed for nonradioactive parameters (acidity, nitrates, phosphates, fluorides, and hexavalent chromium) In addition, all daily samples are composited into weekly samples and analyzed for radioactive materials Monthly samples, composited from the weekly composite samples, are analyzed for forty-two additional elements

From the four major reservoirs in the area, samples were taken semimonthly during 1972 Radioactivity in tap water samples from surrounding communities is also routinely determined Twice yearly, samples are collected from thirty-five bodies of water to a distance of 20 miles from Rocky Flats. These samples are analyzed for uranium plus plutonium, and specifically for plutonium Americium concentrations are determined in the semimonthly samples

Vegetation and Soil

Soil and vegetation samples are collected at 6-month intervals from areas around the plant site Over ninety vegetation samples, taken from an area of over 300 square

miles around the plant site, are collected and analyzed for plutonium

Semiannual soil samples are collected from sixty locations at 1-, 2-, and 5-mile distances from the plant site and are analyzed specifically for plutonium

RESULTS

Air

Total long-lived alpha *releases* during 1972, from all plutonium operations, totaled 58 microcuries This includes naturally occurring alpha emitting materials in addition to plutonium

Less than 8 7 microcuries of total long-lived alpha emitters were released from enriched uranium operations

Total annual beryllium releases were less than 4 3 grams The standard allows a release of 10 grams per day

Total long-lived alpha results (which include natural background radiation) from community samples for 1972, averaged less than 24% of the standard for plutonium in air

Onsite samples for total long-lived alpha activity averaged less than 10% of the plutonium standard

Plutonium concentrations for the year, collected by the high volume samplers located at a 2 to 4-mile radius of the plant, averaged less than 2% of the guideline for plutonium

Water

Radioactivity in onsite water for 1972 averaged less than 1% of the guidelines for plutonium, and less than 1% of the guidelines for uranium plus plutonium in water

Offsite, samples from Walnut Creek at Indiana Street averaged 0 6% of the guideline for uranium plus plutonium, 0 5% of the plutonium guideline, and less than 0 1% of the guideline for americium in water

Plutonium in reservoir samples averaged less than 0 03% of the guideline, and in tap water samples the average was less than 0 02%

The 1972 analyses showed that the surrounding bodies of water less than 5 miles from the plant averaged less than 0 03% and those at distances greater than 5 miles averaged less than 0 02% of the guideline for plutonium in water

Vegetation and Soil

Average plutonium concentration in vegetation collected during 1972 was $0\ 33 \times 10^{-6}$ microcuries per gram (dry) There were no standards established for plutonium in or on vegetation or in soil during 1972 Analyses of soil samples indicated no apparent movement of plutonium in soil from previous years, or any additional plutonium added to the soil

STANDARDS

The standards or guidelines referred to in this summary are applicable throughout the United States to all facilities, including hospitals, x-ray laboratories, and research facilities, that use or produce radiation or radioactive materials

The guidelines or standards for radioactive substances in water and in air are based on fundamental exposure standards These standards are defined by law in the Code of Federal Regulations, Title 10, Chapter 20 and are reviewed by independent national and international agencies

ENVIRONMENTAL SAMPLING
TABULAR SUMMATION ROCKY FLATS 1972

Total Long-Lived Alpha Releases

Plutonium Areas	Enriched Uranium Areas	Depleted Uranium Areas	Total Beryllium Area Release
<58μCi	<8 7μCi	<64μCi	<4 3 grams

Total Long-Lived Alpha activity in air as % of Standards for plutonium Concentrations in air

Onsite (average)*	< 9 8%
Offsite	
Boulder	<24 5%
Broomfield	<21 0%
Coal Creek	<17 0%
Denver	<28 0%
Golden	<23.5%
Lafayette	<28.5%
Marshall	<29.5%
Wagner	<21 0%
Westminster	<28 0%
Average*	<24 0%

*Volume weighted average

Plutonium Concentrations in Air at a 2 to 4-mile radius of the plant as % of plutonium standards

Location	% of Standard
S-26	<0 6
S-27	<0 6
S-28	<0 4
S-29	<1 1
S-30	<0 4
S-31	<0 9
S-32	<1 1
S-33	<0 7
S-34	<1 6
S-35	<0 8
S-36	<0 2
S-37	<0 5
Average (based on annual numerical average concentrations)	<0 7

Radioactivity in Waters Percent of Standards

	Uranium + Plutonium	Plutonium	Americium
ONSITE			
North Walnut Creek (A)	<0 16%	<0 10%	–
South Walnut Creek (B-4)	1 00%	0 89%	<0 07%
Woman Creek (C)	0 13%	0 08%	–
OFFSITE			
Walnut Creek at Indiana	0 62%	0 53%	<0 08%
Reservoirs			
Baseline	<0 06%	<0 03%	–
Great Western	<0 08%	<0 04%	<0 03%
Ralston	<0 10%	<0 03%	
Standley	<0 06%	<0 02%	<0 01%
Averages**	<0 08%	<0 03%	<0 02%
Tap Waters			
Arvada	<0 04%	<0 02%	
Boulder	<0 03%	<0 02%	
Broomfield	<0 05%	<0 03%	
Denver	<0 07%	<0 04%	
Golden	<0 06%	<0 03%	
Lafayette	<0 04%	<0 03%	
Louisville	<0 04%	<0 02%	
Thornton	<0 14%	<0 04%	
Westminster	<0 04%	<0 03%	
Averages**	<0 05	<0 02	

**Sample weighted averages

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F-21761 (REV 11-70) IP 18-2 DESTROY PREVIOUS ISSUES

May 1, 1973

The Honorable Peter H. Dominick
248 Old Senate Office Building
Washington, D. C. 20510

Dear Senator Dominick·

The enclosed Annual Environmental Report and its more abbreviated Summary describe our monitoring programs for 1972. They are part of a continuing effort to provide the public with relevant information expressed in a manner understandable to an interested layman and the scientific community.

As you will see from the Summary, we analyzed over 60,000 environmental samples in 1972, principally air, water, soil and vegetation. All of the results were well below the guidelines established by State and Federal regulations. The results of our monitoring programs and those results obtained by the Colorado Department of Health are exchanged in a monthly meeting, which frequently includes the Environmental Protection Agency. Our data shows no significant differences from either that of the State Health Department or the EPA.

We are interested in any comments or constructive criticism you might have concerning our environmental monitoring programs or the manner in which we report them. Our goal is to disseminate accurate, understandable information as widely as possible, and your suggestions would be appreciated.

Yours truly,

J. H. Hanes
General Manager

EVALUATION OF DOSE TO THE PUBLIC NEAR ROCKY FLATS

Addendum to the Rocky Flats 1972 Environmental Monitoring Report
RFP-ENV-72
April 13, 1973

I Introduction

Rocky Flats releases uranium and plutonium radionuclides through effluent air and water The effluents are carefully monitored at the point of release and at the plant boundary In addition, measurements are made of air and drinking water at points of consumption by the general public

II Summary

The concentrations of uranium and plutonium in public areas as a result of air and water effluent releases from the Rocky Flats Plant are all below one percent of the relevant AECM 0524 Radioactivity Concentration Guides (RCG)

III Monitoring Data and Analysis

a Water

Bimonthly water samples are collected from nine tap water locations around the Rocky Flats areas These locations include Arvada, Boulder, Broomfield, Denver, Golden, Lafayette, Louisville, Thornton and Westminster Following is the annual average plutonium and plutonium-plus-uranium concentrations for these locations and a comparison with the applicable standard The standard for uranium is $10{,}000 \times 10^{-9}$ μCi/ml and for plutonium-239 is 1667×10^{-9} μCi/ml The standard for soluble uranium plus plutonium is

$$\frac{C_U}{RCG_U} + \frac{C_{Pu}}{RCG_{Pu}} < 1$$

Tap Water Samples

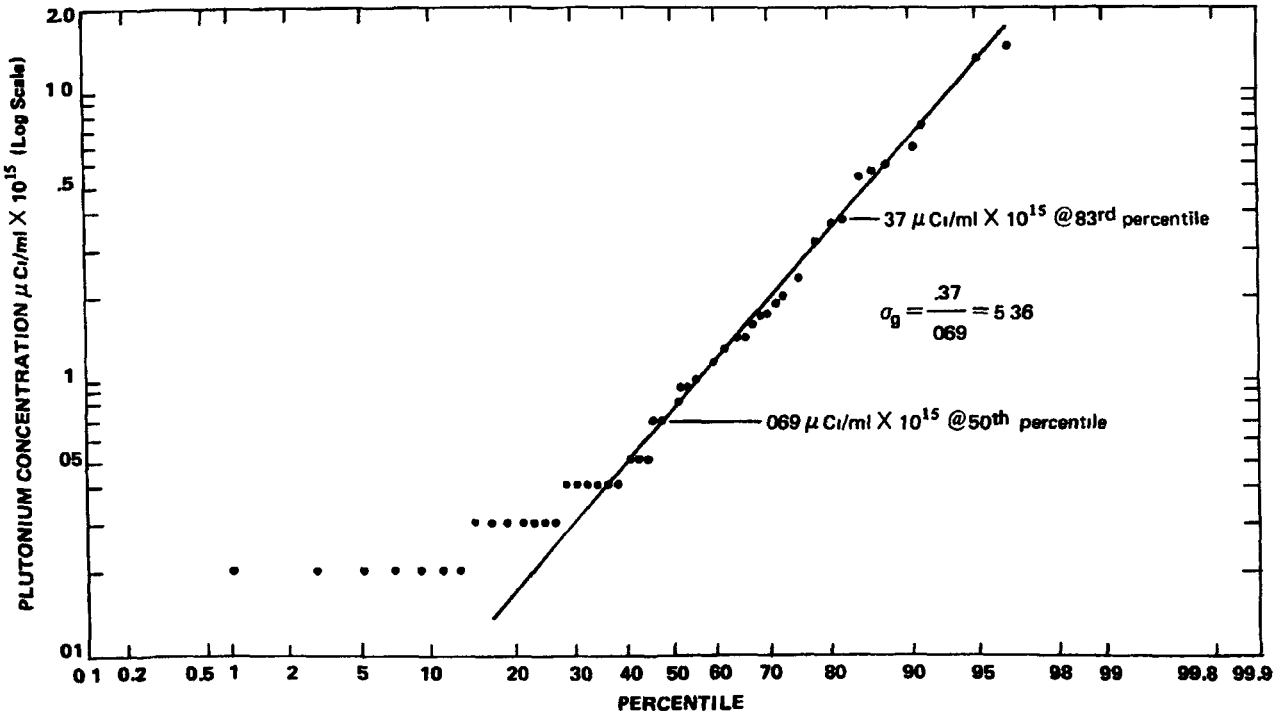
	U + Pu		Pu	
Location	Avg Conc ($\times 10^{-9}$ μCi/ml)	% of RCG	Avg Conc ($\times 10^{-9}$ μCi/ml)	% of RCG
Arvada	<1 81 ±37%	<0 04	<0 38 ±52%	<0 02
Boulder	<1 40 ±29%	<0 03	<0 37 ±47%	<0 02
Broomfield	<2 67 ±29%	<0 05	<0 46 ±61%	<0 03
Denver	3 92 ±39%	0 07	<0 62 ±67%	<0 04
Golden	4 04 ±66%	0 06	<0 48 ±61%	<0 03
Lafayette	1 43 ±50%	<0 04	<0 48 ±62%	<0 03
Louisville	1 97 ±37%	<0 04	<0 36 ±59%	<0 02
Thornton	10 25 ±48%	<0 14	<0 66 ±60%	<0 04
Westminster	2 14 ±36%	0 04	<0 45 ±52%	<0 03
Average	<3 20 ±21%	<0 05	<0 31 ±21%	<0 02

b Air is sampled continuously at twelve locations around the plant at distances between two and four miles The samples are collected daily on Whatman 41 filter paper at an average flow rate of 20-25 cfm The daily filters are composited into weekly samples, whose volumes vary between 3000 and 6000 m^3, and are radiochemically analyzed specifically for plutonium. These stations sample the air to which the general public in the vicinity of the plant might be exposed The major population centers are at a greater distance (10 to 20 miles) and therefore are exposed to a lower plutonium concentration in air from any Rocky Flats contribution because of greater dilution Log-normal statistics are used in the numerical analysis of the data from these stations. Following is a summary of the annual average plutonium concentrations at these locations and a comparison with the Radioactivity Concentration Guide.

The RCG used is for soluble plutonium-239 in air and is 20×10^{-15} μCi/ml The use of the soluble plutonium RCG adds additional conservatism to the interpretation since the plutonium is probably in an insoluble form for which the RCG is 330×10^{-15} μCi/ml.

Air Samples

Sampler	Direction from Center of Plant	Avg Pu Conc ($\times 10^{-15}$ μCi/ml)	% of RCG
S-26	W	0 066	0 33
S 27	W	0 052	0 26
S-28	NW	0 040	0 20
S-29	NW	0 043	0 22
S-30	N	0 033	0 17
S-31	NE	0 049	0 25
S-32	E	0 064	0 32
S-33	E	0 065	0 33
S-34	SE	0 060	0 30
S-35	S	0.049	0 25
S-36	S	0 031	0 16
S-37	SW	0 039	0 20
Average		0.044	0 22


PLUTONIUM CONCENTRATION μ Ci/ml X 10^15 (Log Scale)
2.0
1.0
.5
1
05
01
0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9
PERCENTILE
37 μ Ci/ml X 10^15 @83rd percentile
σg = .37/069 = 5.36
069 μ Ci/ml X 10^15 @50th percentile